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Editorial Notes

Future Gas Heating

At this period of summer holidays, with the bright sun spreading cheerfulness and building-up health, it may appear unkind to draw a contrast with the dark wintry days which lie ahead in this country—to the time when, by artificial sources of heat, we attempt to imitate the present ideal conditions of sunshine and fresh air. It is, however, salutary to consider in what spirit and with what new developments we are going to approach, as an Industry, the coming heating season, to question whether we could not do better than hitherto both for ourselves and for our customers. It is now that we should make adequate plans for the heating season in next winter's gloomy days. We know the requirements for comfort are determined by air temperature, radiation, ventilation, and a cheerful appearance of warmth. We know, too, that flexibility between these factors is needed. How are we to achieve the best measure of flexibility to ensure comfort?

The gas fire heats and ventilates and it quickly produces radiant heat in a cold room. We doubt, however, whether it can be said to provide ideally for all circumstances, while appreciating the enormous advances which have been made in its performance and the quality of radiant energy emitted. There are conditions when, in a cold room, we have to sit too close to the gas fire to offset the chill from the cold walls and surroundings behind. We cannot rest content with less than perfection; and it is with the liveliest satisfaction that we hear of new developments in gas heating which are already well advanced. The future, we suggest, will see a combination of air heating and radiant warmth by gas. There will be available small independent gas units serving to take the chill off the air—to effect what we have termed in these columns "background heating." Near the windows comfort conditions will be virtually as satisfactory as near the fire, and since the heating will be amply adequate the windows may be left open to ensure fresh air supply. Moreover, we shall soon be able to reduce the heat output of a gas fire to less than half with practically no change in its bright appearance—again helping to bring about that desirable degree of flexibility. Small gas units fixed below the windows will act as auxiliaries to the gas fire; they will be available at low first cost, with or without thermostatic control, and with a gas rate of 4 to 6 cu.ft. per hour for medium-size rooms.

These units will be unprovided with flues. In view of his letter in our Correspondence Columns last week, Mr. A. H. Barker should find this fact particularly interesting. In spite of his strong personal views on the use of gas in this way for promoting comfort, we suggest that Mr. Barker would find it impossible at this dilution justifiably to criticize these small heating units because they are flueless. Lord Dawson's Committee of the Royal College of Physicians, for whose conclusions, apparently, Mr. Barker has little use, confirms experience that a flueless heater of excessive gas rate in relation to ventilation, if not necessarily dangerous to health, may at least be criticized as creating smells and stuffiness. The auxiliary gas heating units we are discussing, however, are far below these limits; yet as auxiliaries to the fire which radiates and ventilates their aid to comfort is remarkable, their running cost is modest, while their potential consumption to the Gas Industry represents a substantial addition. Happily these developments come at a time when spreading acceptance of attractive tariffs enables gas to be considered the heating agent for continuous rather than intermittent requirements.

If there remains controversy or hesitation over the use of flueless heaters its cause must lie in the doubt whether use may not lead to abuse, but the development to which we refer appears so safeguarded in this respect as to leave no room for criticism. Correct gas rate is, as we have emphasized time and time again, absolutely essential to the use of flueless gas heaters. Granted that proper attention is paid to this all-important aspect, flueless gas heating, with, as Mr. Barker himself admits, its obvious economy, can be recommended with confidence.

Competition

" For a number of purposes other than heating, such as decorative lighting, independent power units, and wireless, electricity has a virtual monopoly. In the interests of the community and of the expansion for these purposes of the electrical industry itself, it is desirable that these services should be provided at the lowest possible price." This quotation is from the Paper on the future of gas appliance design by Mr. Masterman at the Institution Meeting; and it will be recalled that he went on to point to the evidence that the interests of the community have not always been reflected in the electrical supply price policy, and that in place of using a two-part tariff to enable electricity for special purposes to be sold at the lowest rate, high prices have been maintained for these purposes to subsidize the use of current for heating purposes where its use shows no essential advantage to the user. In the absence of effective check there appears no technical reason why the prices of current for essential purposes should not be raised well above their present level and so subsidize the use of greater quantities of electricity for heating purposes.

The Gas Industry has a check which it should use more effectively. We refer to retention of the gas lighting load not only in street and factory, but also in the home. If we were content to resign the field of lighting we should at once make it easier for electricity undertakings to charge a higher rate for lighting so that they might decrease their charges for the other purposes in which they are in competition with gas. This point cannot be too strongly stressed. The importance of the public lighting load to the Gas Industry—and it is satisfactory that sales in this direction are on the increase—is well brought out in the latest edition of " Field's Analysis," a review of which was published in the " JOURNAL " a fortnight ago. The sales of gas per public lamp closely approximate the sales of gas per prepayment consumer. The undertakings dealt with in the Analysis number only 40, but they represent sales of gas amounting to about 60% of the output of the whole of the gas undertakings in Great Britain and Ireland. In 1936 there were 418,950 public lamps lighted by gas in the areas of these 40 undertakings. In other words, loss of this load would more than represent the loss of well over 400,000 prepayment consumers to the undertakings concerned.

Conditions in the United States of America differ from those obtaining in the Gas Industry of this country. The American Gas Industry has abandoned its lighting load, though some small attempt is now been made to popularize gas floodlighting. In the United States, also, there are many instances of gas and electricity undertakings being under the control of a single company. It is with this in mind, and in view of Mr. Masterman's comments on electrical competition in his Institution Paper, that we turn to a Paper recently presented by Mr. Herman Russell, President of the American Gas Association, at a New York-New Jersey Regional Gas Sales Conference. Mr. Russell is President of the Rochester (N.Y.) Gas and Electric Corporation, and his Paper, based on a thorough analysis and extensive survey of the domestic market, is concerned with the sales responsibilities and sales policy of a combination gas and electricity company. As a result of this exhaustive analysis of the operation of a combined concern he arrives at the very broad conclusion that where motive power is desired electric energy is generally preferable from the viewpoint of both consumer and company, and where heat is required gas is superior. Moreover, in regard to fuel applications the efficiencies of gas appliances are susceptible to much greater improvement than are electrical appliances; and with the continued improvement in the efficiency and adaptability of gas appliances which is certain to take place, gas from a heat unit cost basis is sure to widen the present margin it already enjoys over electricity.

In the Consumer's Interest

In the study undertaken at Rochester the aim was first to determine what was in the domestic consumer's interests and secondly which service or combination of services brought in the greatest net revenue to the Company; policy was based on the results of this analysis. Investigations were undertaken to show the cost to the consumer and the return to the Company covering the cooker, water heater, and refrigerator for gas and electric service and various combinations of the two services. The study was, of course, based on the gas and electricity rates in force at Rochester, but similar surveys for other combined undertakings indicate that the conclusions drawn are generally true. It was shown that gas service for cooking only is unprofitable—that to show an adequate return on its domestic business a gas department of a combined company, and this applies also to a " straight " gas company, the cooking load must be retained and the water heating load promoted. Also, the figures indicate that domestic gas refrigeration should be aggressively pushed by either type of company. In regard to cooking by electricity, here again this is economically inadvisable unless the water heating load also be gained. Then there is the point of view of the consumer. Complete electric service—Mr. Russell excludes lighting—though profitable to the Company involves the consumer in substantially more cost than comparable gas service. " Comparable " is hardly the correct word, for gas has the advantage on the score of flexibility, reliability, and speed, and appliance costs and maintenance charges are more favourable to gas. " Where," states Mr. Russell, " the Rochester Company can readily deliver both gas and electric service in new territory it should not consider straight electric service for the reason that such service, to be profitable, must be considerably more expensive to the consumer and would require several times as much outlay of new capital by the Company. If electric rates for cooking and water heating were to be made competitive with present gas rates so as to bring the cost of complete electric service down comparable with the present cost of combined service, the return from all electric service would be more than wiped out." Which adds point to Mr. Masterman's contention that there must be effective check on the price policies of electricity undertakings if the public is to be served to its best advantage.

The Field for Development

In the United States the " house heating " load is segregated from the other domestic loads, but it seems obvious that in this field electricity cannot compete, though Mr. Russell does not consider this aspect. We have in the foregoing emphasized that the Gas Industry should do its utmost to retain its lighting load; and one of the lessons to be drawn from Mr. Russell's Paper is that, while retaining the cooking load we should not regard this as in any way a sufficient counter to electrical competition. We cannot regard the position with satisfaction unless other domestic gas loads—water heating, space heating, and refrigeration—are also connected. At

the present time it is doubtful if gas supplies more than 20% of the present domestic hot water requirements of the country, themselves a fraction of the potential demand, while the provision of gas central heating to 1% of the gas consumers in the country would increase gas sales by about 10%. These estimates were given in the Institution Paper by Mr. Masterman, who also estimated that the introduction of flueless heaters into halls and passages in smaller property would, on the basis of one such heater per home, represent an increase of nearly 50% in sales of gas. It is with such thoughts as these in mind that we should approach the development of the Gas Industry.

The question arises from study of Mr. Russell's Paper, How ought we to set about the more speedily to gain this new business which lies ahead? In this connection the outcome of a survey of a thousand homes in Rochester, carried out in an attempt to ascertain the housewife's attitude towards gas, is of much interest. In spite of the fact that there are very few electric cookers or water heaters in use in the city, the survey indicated that the average Rochester housewife is decidedly electric minded, thanks to electric light, the vacuum, radio, and so on, that she knows little of the merits and economy of the modern gas cooker, water heater, and refrigerator, and that she has not been led fully to appreciate the benefits of having at command an ample supply of hot water. Perhaps a similar survey in this country would paint a somewhat rosier picture, but the future demands greater general sales effort, including the provision of attractive tariffs for gas sold, to bring about a better understanding on the part of the public of the many advantages in the way of economy and performance which gas has to offer. We require, as we have said many times before in these columns, more individual selling effort on the part of all engaged in or connected with the Gas Industry, so that the very great potentialities of gas may be viewed in proper perspective. The future of the Industry will also depend in large measure on the development of and improvement in processes and appliances—development as the result of co-operative research and investigation undertaken by gas undertakings and makers of appliances. There can be no doubt as to the brightness of this future if the matter is tackled enthusiastically on these lines.

Attractive Tariffs

We have mentioned the need for the introduction of attractive tariffs to secure the development and prosperity of the Industry. This problem was the subject of a report by the Tariffs Committee of the International Gas Union at the recent Conference in Paris. The report, a summary of which was given in the "Journal" last week, "constitutes neither a doctrine, a theory, nor an application, but merely endeavours to set out the opinion of the gas-making world on a question which appears to be vital but of which certain aspects appear to be quite unknown to the outside world." The question is undoubtedly vital, and it is true also that the application of tariffs other than the flat rate is apt to be misunderstood and misinterpreted by local authorities and by the public—and this in spite of considerable experience of a diversity of tariffs for electricity. Yet flat rates, apart from their manifest simplicity, have nothing in their favour except their misleading appearance of fairness. Block rates and two-part tariffs are logical in their conception. The only way in which an undertaking having high average costs as a result of supplying small domestic consumers can reduce the average selling price and thus lower the rate to small consumers is by developing both domestic and industrial consumptions at low but logically calculated rates. The erroneous argument is all too often put forward, however, that the small consumer paying a higher price for gas is, in effect, subsidizing the large-scale user; to avoid misunderstanding it is necessary to make clear the facts of the case. Public opinion has, of course, to be taken into account, and this will be formed by the method of presentation of the tariff by publicity, sales organization, and obviously by the effects produced by it; and for a tariff to be successful it should be made as simple and easy to understand as possible.

The report of the Tariffs Committee is a general survey of the question of gas charging, the dominant note of which—and this we have been emphasizing for years—is the iniquity of the flat rate of charge and its stultifying effect on progress. Admittedly the psychological and social factors have to be taken into account, but tactful presentation of new tariffs should smooth away possible difficulties. "The problem of a new tariff is extremely serious for an undertaking," states the report, which goes on to refer to the possible loss of revenue from the introduction of attractive tariffs. We have discussed this aspect on many occasions. The possibility has, of course, to be faced, but nothing is to be gained without taking some risk, and the experience of those undertakings which have adopted attractive tariffs should infuse confidence. The public is prepared to extend the use of gas if it can do so at lower rates, and it is up to the supplier of gas to make the first move. In any case it has been amply demonstrated that to cling to the flat rate is unsafe from a revenue producing point of view. New rates can be formulated in the knowledge that the cooking service, the heating service, and the hot water service a consumer can obtain from gas are fundamentally greater than can possibly be afforded by electricity. Gas undertakings ought to approach the problem in the belief that the increase in gas consumption due to attractive tariffs will be sufficiently great to give a revenue return in excess of the possible loss.

Encouraging Results

Just as in the months of February and March we are able to record and draw useful inferences from the annual reports of a large number of company-owned gas undertakings whose activities run concurrently with the calendar year, so at the present time we find the results of municipal concerns whose accounts close at March 31 coming in from all parts of the Kingdom. During the past few weeks we have recorded in the columns of the "Journal" particulars of some forty corporation gas departments whose reports have come to hand, and we can say, without fear of contradiction, that their results are in the aggregate quite as encouraging as those of the company-owned undertakings dealt with earlier in the year. As a whole they are indicative of the enlightened policy which governs the activities of the Industry in most areas to-day, while showing by comparison the few instances where lack of that policy or territorial isolation militates against that full measure of progress which is desirable and possible.

In all but two or three cases larger gas sales are recorded—many of them over 3% and at least one as high as 17%; and in almost every case appliance sales show most satisfactory advances, some of the credit for which must, of course, go to the manufacturers, who have been

unsparing in their efforts to produce apparatus whose greater efficiency has gone hand in hand with more attractive lines. As is to be expected, various undertakings report valuable increments in industrial consumptions, for which special rates are offered Particularly interesting, too, are the results of a number of undertakings which have recently installed new carbonizing plant; in several such instances production figures show some quite remarkable improvements, indicating that there need be little hesitancy on the part of those considering the replacement of out-of-date or obsolete plant by modern equipment. The introduction of special tariffs is also reported by a few concerns, where in most cases the considerable concessions thereby granted to consumers have been partially or wholly offset by increased consumptions. In short, progressive policies have shown themselves to be justified without exception.

There is still, however, a tendency among certain undertakings—and this applies equally to company-owned concerns—to set out their final trading results without that full degree of clarity or detail which is desirable in order to simplify comparisons not only with their own preceding reports but with those of other concerns. Doubtless full particulars are presented verbally in such instances to the governing bodies concerned; but there are not always sufficient published data in regard to actual and percentage increases (or decreases) in output or—more illuminating still—to increased or decreased consumptions per consumer, which is so critical a standard by which we must judge the Industry's progress today. It may be that certain undertakings will argue that the publication of their figures in that connection would convey a dispiriting impression; but they would surely at the same time provide stimulation towards renewed efforts to correct the position. If not, they might just as well give it up straightaway and go out of business. Admittedly, the necessary figures can sometimes be arrived at by delving deeply into the accounts and making abstruse calculations—but why should not the undertaking, which has all the relevant figures at its fingertips, do the job? There are statisticians in the Industry (and doubtless outside it as well) thirsting for knowledge of this kind.

Another matter which concerns the published accounts of gas undertakings generally was referred to in the "JOURNAL" recently—namely, that there is no standard form of accounts applicable to gas undertakings. We then suggested that it would not only be of interest, but of utility to the Industry (for reasons some of which we have just outlined), if some such standard could be generally approved and adopted. If it could be accompanied by a universal standard for classification of the items in the accounts, a very useful purpose would be served.

The corporation undertakings' results to date, however, clearly indicate that there are few, if any, municipal authorities who have any reason to regret their ownership of the local gas undertaking.

Personal

Mr. JOHN SMITH, Junior Technical Assistant to the Workington Corporation Gas Department, has been appointed to a similar position with the Hinckley Gas Department. Mr. Smith received his training with the Workington Gas Department.

* * *

Mr. W. L. GALBRAITH, who recently retired from the position of Secretary of the Gas Light and Coke Company, was the recipient of a fitted dressing-case in crocodile leather from members of the Managing Director's and Secretary's Departments. The presentation was made by the General Manager, Mr. R. W. Foot, at an informal gathering at the Head Office. The Chief Officers of the Company subsequently presented Mr. Galbraith with a set of table silver and other articles, including a ring for Mrs. Galbraith.

Obituary

J. H. Curry

Barely a month after his appointment as General Manager and Secretary of Sunderland Gas Company, Mr. John Henry Curry died on Aug. 4 at his home.

Mr. Curry, Secretary of the Company for the past seven years, had been in poor health for more than a year, but was thought to be well on the road to recovery. After a period of illness which prevented him from attending the Annual Meeting of the Company he had returned to work and was at the office on the day before his death.

Aged 54, Mr. Curry was a native of Durham and was educated at Durham Cathedral Choristers' School, singing in the Cathedral choir as a boy. He was with the Newcastle-upon-Tyne and Gateshead Gas Company for 27 years, rising to the post of Distribution Superintendent, before he was appointed Secretary of Sunderland Company in 1930 in succession to the late Norman S. Cox. In July of this year, when Mr. C. Dru Drury retired from the post of General Manager of the gas undertaking, Mr. Curry was appointed to the dual post of General Manager and Secretary.

He took a keen interest in the welfare of the employees of the Company, and was one of the Vice-Presidents of the Gas-Works Sports Club. Until his illness he was a keen golfer. A Freemason of many years' standing, he had held office in the Percy Lodge, Newcastle. He was connected with St. Andrew's Church, Roker. Mr. Curry leaves a widow and one son.

The funeral took place at Bishopwearmouth Cemetery on Friday, being preceded by a service at St. Andrew's Church.

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While on holiday at Donaghadee, Northern Ireland, Mr. H. HAYHURST, Irish Representative of Messrs. Falk, Stadelmann, & Co., Ltd., passed away suddenly on Aug. 5. Mr. Hayhurst had been associated with Messrs. Falk, Stadelmann for 38 years, and had represented the firm in Ireland for nearly a quarter of a century.

In This Week's "JOURNAL"

International Gas Conference.

Having given in full the two British contributions to the International Gas Conference—viz., Mr. R. N. Le Fevre, on "Technical Service for Gas Consumers," and Mr. H. C. Widlake, on "Electrolytic Corrosion of Gas Mains," we continue with our publication of other reports of interest to the Gas Industry in abstract form.

See p. 339.

Gas Manufacture by Electricity.

In a Paper which he read at the Annual Convention of the Canadian Gas Association at Ottawa in June, Mr. A. T. Stuart, Director, Electrolytic Gas Department, Hydro-electric Power Commission, Ontario, discusses the complete gasification with oxygen from electrolyzed water and steam of peat, coke, and mixtures of coal and coke. Since gas was made in these tests at the rate of 250,000 cu.ft. per diem the tests were on a commercial basis and make possible, the author states, the immediate introduction of the oxygen process into industry or gas-works.

See p. 343.

Water-Sealed Gasholder Inspection.

In the course of a Paper to the A.G.A. Joint Committee Conference of the Production and Chemical Committees, Mr. A. T. Ireland, of the Philadelphia Gas-Works Company, describes the precautions observed and steps taken in the inspection of gasholders at Philadelphia. He is convinced that all holders should be inspected at least once every 25 years, if for no other reason than to inspect the permanent frame.

See p. 345.

Gas Input Rates Measurement.

In order to satisfy the need for an inexpensive portable flow meter of suitable accuracy, Mr. F. O. Suffron, Supervisor, Pacific Coast Branch, American Gas Association Testing Laboratories, has developed an instrument, which he describes. This is easily carried by the fitter, indicates quickly and conveniently the rate of gas flow through an orifice without reference to displacement meter readings.

See p. 351.

News in Brief

CURRENT EVENTS IN THE GAS INDUSTRY

A Reduction in the Price of Gas by 3d. per 1,000 cu.ft. in the Tillicoultry area was decided upon at a recent meeting of the Alloa Gas Committee.

Among the Awards at Bakewell Show, one of the leading events in the Sheffield district in August Bank Holiday week, we notice first prize in the open hunter class went to Mr. Ralph Halkett.

Applications Are Invited by the Stockport Gas Department for the position of Assistant Engineer and Manager at a commencing salary of £500 per annum. Further particulars will be found in the advertisement columns of this week's issue.

Among Recent Company Registrations are the Alyth Gas Light Company, Ltd., Mill Street, Alyth, with a capital of £3,000 in 600 shares of £5 each, and the Jedburgh Gas Company, Ltd., 38, High Street, Jedburgh, with a capital of £6,000 in £1 shares.

A Site has been Reserved by the Croydon Gas Company for the erection in the near future of up-to-date gas showroom premises in the principal shopping thoroughfare of the newly-developed residential district of Selsdon, which lies between Addington and Sanderstead.

An Increase in the Price of Gas of 2d. per 1,000 cu.ft. is announced by the Falkirk Gas Department, making the price 2s. 10d. for prepayment meter users and 2s. 8d. for ordinary consumers, a discount of 6d. and 4d., respectively, per 1,000 cu.ft. being allowed to all who use more than 22,500 cu.ft. per annum.

A Reduction in the price of gas next year of 1d. per 1,000 cu.ft. has been recommended by the Glasgow Gas Committee. This decrease will make a basic rate of 2s. 10d. per 1,000 cu.ft. During the past four years the price of gas has been reduced 8d. per 1,000 cu.ft. In the course of the year there has been a surplus of £51,252, and in view of this it is agreed to make the reduction.

A Tudoresque Showroom has been decided upon by the Oldham Gas-Works Committee, who want an outstanding building in the centre of the town. One dissentient member said that while appreciating period work of that kind, he would prefer an ultra-modern building. The proposed building was all right in its way, but was old-fashioned. The Mayor remarked that Tudor period architecture was the only type which had lived through the ages. It had been revived again, and he thought Oldham would be proud of it.

An Increased Price for Gas is announced by the Dumfries Town Council, who have raised the price 4d. per 1,000 cu.ft., making the new figures 3s. 1d. for ordinary meters, 3s. 5d. for prepayment meters, and 2s. 11d. for power.

New Showrooms were recently opened by the South Metropolitan Gas Company at Court Road, Mottingham. An attractive modern frontage contains a large window, which reveals the pleasing little showroom within, where a representative display of gas appliances, including a comprehensive water heating section, gives local consumers a wide choice. New showroom premises have also been opened by the South Metropolitan Company at Charlton, and here again a modernistic exterior invites an inspection of the tastefully laid-out displays within.

Important Lighting Contracts have recently been secured by the South Suburban Gas Company for a number of streets in different parts of their area of supply. Some fine stretches of lighting are to be seen at Sidcup and also on the main Hastings Road between Bromley Common and Farnborough, consisting of the latest type of clock-controlled Sugg's "Rochester" lamps on high columns. The newly-widened road from Bromley to Hayes has also been completely relighted with clock-controlled Sugg's lamps, the installation including gas-illuminated bollards on the refuge islands.

Forthcoming Engagements

No Meeting of the Central Executive Board of the National Gas Council, or of the Central Committee of the Federation of Gas Employers, will be held during the month of August.

Sept.

6.—LONDON AND COUNTIES COKE ASSOCIATION.—Technical Committee, 2.30 p.m.

6.—4th Meeting Arthur Duckham Memorial Fund Committee, 1, Grosvenor Place, S.W. 1, 4 p.m.

6-9.—A.P.L.E.—14th Annual Meeting and Conference at Folkestone.

9-10.—NORTH BRITISH ASSOCIATION.—Annual Meeting at Edinburgh.

14.—N.G.C.—Central Executive Board Meeting, 2.30 p.m.

15.—I.G.E.—Finance Committee, 10 a.m.; Membership Committee, 11 a.m.; Research Executive Committee, 2.30 p.m.

16.—WALES AND MONMOUTHSHIRE ASSOCIATION.—General Meeting at Porthcawl.

16.—I.G.E.—Gas Education Executive Committee, 11 a.m.; Refractory Materials Joint Committee, 2.30 p.m.

17.—I.G.E.—Joint Lighting Committee, 2.30 p.m.

20.—LONDON AND COUNTIES COKE ASSOCIATION.—Executive Committee, 11.15 a.m.; Central Committee, 2.30 p.m.

23.—S.B.G.I.—Council Meeting, 11 a.m.

Amalgamation and Grouping

Portsmouth and Hayling Island.

The Hayling Island Gas Company, on the celebration of its diamond jubilee, has ceased to exist as a separate concern.

The Company was recently acquired by the Portsmouth and Gosport Company, and, on Aug. 5, Hayling Island took its supply from the Hilsea Works.

The new supply from Portsmouth was turned on by the Chairman of the Company (Alderman F. Beddow, D.Sc., J.P.). Later the Chairman of the former Hayling Island Company (Alderman Major H. D. Gilbert, J.P.) turned another valve, and the Portsmouth gas passed from the new main into the old Company's mains.

Alderman F. Beddow later presided at a luncheon at the Royal Hotel and among those present were Mr. T. Carmichael (Vice-Chairman and General Manager of the Portsmouth Company), Mr. F. Kilpatrick and Mr. F. R. Snook (Directors), and Major H. D. Gilbert, Mr. E. W. Gilbert, and Mr. A. P. Patey (Directors of the former Hayling Island Company), and officials of both Companies.

Alderman Beddow remarked that they had met not only to celebrate the absorption of the old Island Company, but also to recognize Alderman Gilbert's 30 years' association with that Company.

A presentation of a silver cigar box to Alderman Gilbert was made on behalf of the Portsmouth Company by Mr. Carmichael.

Mr. Carmichael said that for many years he had discussed with Major Gilbert the acquisition of the Company, and it was only last year they got down seriously to details. The Portsmouth Company had had the advantage of selling cheap gas for many years, and had brought the price down to 7d. per therm. They had already announced a reduction in price in Hayling, and he was authorized by the Board to say that at an early date they hoped that a further reduction would be made there. They looked forward to rapid developments. Mr. Carmichael acknowledged the work of various officials in the carrying out of the extension to Hayling and said the presentation to Major Gilbert expressed in tangible form their appreciation of his long association with the Island Company and of his assistance in bringing about the amalgamation.

Alderman Major Gilbert, replying, said Hayling must benefit by the change.

Signal-Lieut. J. Combs said they had pleasure in knowing that in the acquisition of the old Company no labour would be displaced.

Mr. E. Edmonds finally proposed the toast of "The Chairman," which was heartily honoured.

The Gas Light and Coke Company's Two New Showrooms

The accompanying photographs give glimpses of the two fine new showrooms of the Gas Light and Coke Company—at Edgware Road and Leytonstone—the official openings of which were reported in last week's "JOURNAL." On the *left* is a view of the striking exterior of the Edgware Road building, with its marble and Roman stone finish, steam fountain, and illuminated clock, bearing on its face the signs of the Zodiac, while below are interior views of the Edgware Road showroom (*left*) and Leytonstone showroom (*right*), which give a good idea of their spaciousness and pleasing decoration schemes.

Public Lighting of Liverpool

City Lighting Engineer's Report

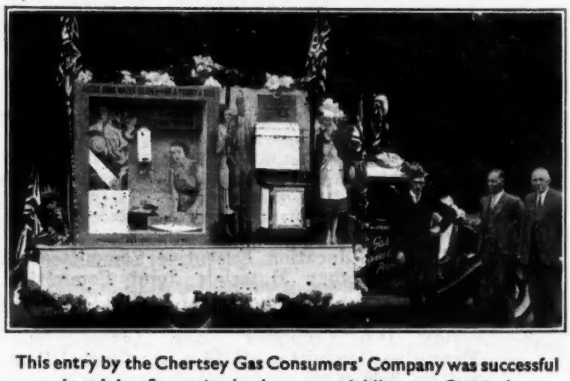
The Liverpool City Lighting Engineer reports for the year ended March 31, 1937, that the mileage of streets, courts, and passages lighted at the end of the year amounted to 940¾ miles, as compared with 930½ miles at the commencement, showing an increase of 10¼ miles as compared with an increase of 15⅛ miles in the previous year. The mileage is made up as follows: Gas 597½, electricity 343¼, and oil 1/44.

The net mileage of gas-lighted streets has decreased by 17¾ miles and the number of lamps by 480, this being due to a policy of substituting electricity for gas.

In consequence of the increased cost of coal the price of gas for street lighting purposes was increased from 7·4d. to 7·6d. per therm, less 20%, or 2s. 4·88d. net per 1,000 cu.ft. when the consumption is 850,000 therms or 178,925,000 cu.ft. and upwards per annum. During the past year the consumption amounted to 893,823 therms (188,173,268 cu.ft.) as compared with 913,829 therms (192,385,057 cu.ft.) the previous year, while the total charges for gas consumed for street lighting purposes amounted to £22,756, as compared with £22,541. The total number of gas mantles used during the year was 80,000, as compared with 83,780 the preceding year, equalling an average of 3·38 and 3·436 per burner per annum, respectively.

The number of gas meters tested during the year was 31,429, compared with 31,046 the preceding year, an increase of 383 or 1·23%. Of these 1,074 or 3·41% were rejected, as compared with 8·47% the preceding year, and 21,637, or 68·84%, were of the prepayment type. The total expenditure on this section of the Department amounted to £1,829, and the fees received amounted to £2,234, leaving a net surplus of £405, as compared with a net surplus of £565 the preceding year.

A Prize-Winning Carnival Effort



This entry by the Chertsey Gas Consumers' Company was successful in gaining first prize in the recent Addlestone Carnival.

POINTS FROM PAPERS BEFORE THE

International Gas Union

Experimental Determination and Calculation of Combustion Temperatures, with Special Reference to Town Gas

The Author, Prof. G. Ribaud, who is in charge of the department of physical research of the Paris Gas Company, points out that, for many laboratory or industrial operations, the effective combustion temperature rather than the calorific value of a gas is the important factor.

He describes the only accurate method which has been developed for the experimental determination of combustion temperatures—namely, the method based on the inversion of a spectral line. An incandescent source of light furnishing a continuous spectrum and having a known temperature which can be varied is focussed on to the non-luminous gas flame of which the temperature is to be measured, the flame being rendered monochromatic by introduction of a sodium salt. Beyond the flame is a spectroscope which enables the double sodium line to be viewed. When the temperature of the source is lower than that of the flame, the sodium lines appear luminous against the continuous spectrum. When the source is hotter than the flame, the lines appear dark amid the spectrum. The temperature of the source is adjusted until the luminous sodium lines just disappear, and this temperature is equal to the flame temperature of the gas. The temperature distribution in a flame can be explored by local introduction of the sodium salt.

Methods for the calculation of combustion temperatures involve an accurate knowledge of the specific heats and dissociation constants of gases at high temperatures. In this connection it is necessary to take into account the dissociation of carbon dioxide into carbon monoxide and oxygen and the dissociation of water vapour on the one hand into hydrogen and oxygen and on the other hand into hydroxyl and hydrogen. Moreover, at still higher temperatures dissociation of molecular hydrogen and oxygen into atoms also plays a part. Combustion temperatures calculated without allowance for dissociation are considerably higher than the true combustion temperatures calculated with such allowance.

It is, however, a lengthy and intricate operation to perform calculations in which full allowance for dissociation is made. The Author has therefore developed graphical methods which render a considerable simplification possible and, at the same time, enable the effect of preheat to be taken into account. They involve the use of heat-content/temperature diagrams in which the heat content is not the conventional one calculated from the specific heat of the combustion gas, but a total heat content which includes the heat which has been taken up as heat of dissociation. These diagrams have been worked out for varying ratios of inerts—*i.e.*, gases playing no part in the dissociation, since the amount of dissociation at any temperature depends on the partial pressure of the carbon dioxide and water vapour present. The data are also presented in tabular form and their method of use is explained. The method can be extended to cover the case of combustion with excess or deficiency of air. For this, further tables are necessary and have been published by the Author [Chaleur et Industrie, May and June, 1937].

Consideration is given to the effect of moisture vapour in the air and gas and to the effect of the presence of inerts in coal gas. It is concluded that 10% of nitrogen lowers the combustion temperature of town gas by about 20° C., while twice this effect is produced by a similar amount of carbon dioxide. In comparison with dry conditions, saturation of the gas and air with water vapour at 20° C. results in a fall of about 30° C. in the combustion temperature.

As regards gases consisting essentially of hydrocarbons, carbon monoxide, and hydrogen, the combustion temperature falls with increase in the content of hydrocarbons, ethylene having a greater effect than a similar concentration of methane. Hence flame temperature decreases with increase in the calorific value of the gas. Hydrocarbon fuels, apart from acetylene, give a lower combustion temperature than does town gas.

Guarantees and Guarantee Tests of Gas-Making Plant

Report of the Study Committee

At the 1934 Conference, a report on the Co-ordination of the Methods of Testing and Guaranteeing Gas-Making Plants was presented by the Deutscher Verein von Gas- und Wasserfachmännern. A lengthy abstract was published in the "JOURNAL," 1934, 207, 519. In the interval, the report has been examined by an international Study Committee under the chairmanship of Herr H. Müller with Dr. Plenz as reporter, the British representative being Mr. George Dixon, Engineer and Manager of the Nottingham Gas Department. As a result of the deliberations of the Committee, a set of rules has been drafted by Germany to cover the form of guarantees which may be conveniently given in respect of gas-works carbonizing plant and the means whereby the fulfilment of the guarantees may be verified. It has received the unanimous approval of the members of the Study Committee and was submitted to the recent 1937 Conference with a recommendation that it be accepted by all the countries belonging to the Union. The rules are essentially similar to those put forward in 1934 though recognition has now been given to the fact that circumstances differ in each country. Hence the new rules are divided into a text which is applicable to all countries and a marginal commentary containing numerical prescriptions. It is intended that each country should lay down its own numerical schedule. The marginal features included in the present draft relate to German practice. They cover the tolerances applicable to the various clauses of the test, the temperature, pressure, and moisture bases for gas and calorific value measurements, the guaranteed working life of carbonizing plant, &c., and are generally similar to those which were reproduced in the abstract referred to above. A new departure is the recognition that the guarantee which may be given for the working life of the plant depends on the type—namely, whether continuous or intermittent and, in the latter case, whether the carbonizing time is greater or less than 24 hours. It is to be noted, among the numerical features, that whereas the earlier version of the code contemplated a maximum guarantee period of five years from the date of the installation for the refractory materials, the maximum period is now limited to three years.

As regards testing technique, it is suggested that, in so far as methods have been standardized in particular countries, they should be maintained and should be incorporated in the commentary. The Study Committee intends, however, to arrange for an interchange of methods with a view to the securing of as much uniformity as possible. It contemplates, also, the formulation of guarantees and guarantee tests for producers after the promulgation and approval of the work it has so far carried out.

Co-ordination of Methods of Testing Gas Appliances

Report of the Study Committee

At the request of the International Gas Union, the Union Syndicale de l'Industrie du Gaz en France undertook the preparation of a report on the "Co-ordination of Methods of Testing Gas Appliances" for presentation to the 1934 Congress. [See "JOURNAL," 1934, Vol. 207, page 573.] The discussion to which the report gave rise showed that the desired co-ordination could only materialize as a result of prolonged efforts requiring the collaboration of all the National Gas Associations. Hence an International Study Committee was constituted under the Chairmanship of M. J. Thuillier with M. G. Reclus as Reporter and Mr. Stephen Lacey as the British representative.

The present report indicates the progress which has been made during the past three years. It commences with an

addendum which brings up-to-date the information presented by the various national organizations as to the methods in use by them and it has now been possible to include, for the first time, details relative to British and Italian practice in the testing of gas appliances. An account is then given of the work of the Study Committee at its four sessions. This work has resulted in a series of resolutions which have been presented for approval by the International Gas Union.

Choice and Definitions of the Essential Characteristics of the Gas Employed in Tests on Appliances.

Resolution A.—The essential characteristics of the gas shall be considered to be: (1) Calorific value, (2) specific gravity, and (3) theoretical CO_2 content of the combustion products.

For calorific value, the gross value is adopted and is defined as the quantity of heat produced by the combustion of unit volume of the gas at constant pressure, the products of combustion being reduced to atmospheric temperature, the air for combustion being saturated with water vapour and the gas being measured dry at a temperature of 0° C., and at a pressure of 760 mm. of mercury.

Specific gravity is defined as the ratio of the weights of equal volumes of gas and air under the same conditions of temperature and pressure, both being saturated with water vapour.

The theoretical CO_2 content of the combustion products by volume is expressed on the dry basis.

Resolution B.—A definition for and a simple method for the determination of ignition velocity should be established with a view to the adoption of this property as one of the essential characteristics of gas.

Definitions of the General Characteristics of Appliances.

Consumption. Resolution C.—For international purposes, the consumption of appliances shall be expressed on both a volume and a thermal basis. The volume consumption is the hourly volume of gas at 0° C., 760 mm., dry consumed by the appliance when equilibrium conditions have been established as a result of the lapse of an adequate period of time after lighting up. The thermal consumption is the number of heat units corresponding to the volume consumption on the basis of the gross calorific value of the gas as defined in Resolution A.

Capacity. Resolution D.—The capacity of an appliance shall be defined as the number of heat units furnished by the appliance in useful form in unit time.

Efficiency. Resolution E.—The efficiency of an appliance shall be defined as the ratio of its capacity to its consumption, both being expressed in terms of heat units.

International Symbols. Resolution F.—So that readers may know immediately whether results are expressed in conformity with the above international definitions, symbols followed by subscript letters *ig* shall be employed in all test reports in which this basis has been adopted. The symbols for volume consumption, thermal consumption, capacity, and efficiency when expressed in accordance with resolutions C, D, and E shall be respectively:

Q_{ig}, C_{ig}, N_{ig}, and η_{ig}.

General Rules Relative to the Safe Working of Appliances.

Tightness. Resolution G.—The test for the tightness of appliances has for its object the exact determination of the quantity of air which they permit to escape in a given time under a constant air-supply pressure.

Lighting Safety. Resolution H.—Complete ignition of a burner shall always be assured when a lighted match is applied to any part of the burner, the gas supply valve of the burner being fully open.

Protection Against Accidental Opening of the Valves. Resolution J.—(1) All valves which, if opened accidentally, would allow passage of gas into an enclosed space shall be provided with safety catches in the shut-off position. (2) Safety pilot devices shall be adopted in all cases in which the lighting of a burner is automatically effected.

Combustion Control. Resolution K.—The quality of combustion shall be characterized by the CO content of the combustion gas on a dry air-free basis.

Control of Evacuation of Combustion Products. Resolution L.—In the case of appliances working in conjunction with flues, a test shall be carried out, at first qualitatively, to verify that there is no escape of combustion products except at the flue connection. If this is not the case, a test shall be made of the exact amount of CO_2 derived from combustion and escaping from the appliance other than from the flue connection.

Mechanical Strength. Resolution M.—Appliances intended to carry pressure shall be provided with a metal plate clearly indicating the maximum permissible pressure.

Protection Against the Risk of Exceeding the Maximum Permissible Gas Consumption. Resolution N.—All appliances which would give trouble if a certain gas consumption were exceeded shall be provided with a metal plate clearly indicating the normal gas consumption and the gross calorific value in terms of which the normal consumption is based.

Notes on the Resolutions.

As regards the essential characteristics of gas, consideration was given to the question as to whether an index of the Ott, Schaack, or Czako type might be adopted. It was felt that though such criteria give useful indications in the control of gas production, especially in works of small and medium size, they should not be specified as essential gas characteristics.

In connection with calorific value, the Committee felt that each country should be at liberty to adopt the basis most suitable for itself but that gross calorific value should always be adopted for international purposes.

Consideration was given to the alternative method of expressing consumption on a volume and thermal basis. It was felt that the volume basis should be retained but that the thermal consumption should also be given. Liberty is left to each country to retain its own practice in expressing thermal consumption uniformly on a gross or net calorific value basis or even to adopt a mixed procedure depending on the types of appliance concerned. For international purposes, however, thermal consumption should always be expressed on a gross calorific value basis.

As regards safety precautions, it was unanimously felt that safety is the prime question and that no order of preference can be drawn up between the various precautions covered by resolutions G to N. In the case of all test codes, the questions of overheating and fire risks receive consideration, the regulations varying with the type of appliance concerned. The Committee hopes to formulate precise rules for each class later on.

Gas Meter Unions

New British Standard Specification

The British Standards Institution has recently issued a standard specification relating to the dimensions and quality of Gas Meter Unions.

This Specification was prepared at the request of the Gas Meters Committee of The Institution of Gas Engineers and relates to three-piece unions for low-pressure gas meters of nominal sizes from ½ in. to 1½ in. inclusive (3 " light " to 50 " light ").

The Specification to which meter unions have hitherto been made was issued by the Board of Trade in 1902. The dimensions and limits laid down were, however, inadequate to ensure interchangeability, although adherence to it by the majority of meter makers vastly simplified the work of preparing the present Specification and it has been found possible to use the 1902 Board of Trade Specification as a basis.

In preparing this British Standard Specification it was found that meter unions were in the main interchangeable, though the actual standards worked to by the various makers were incomplete and numerous. It being the general practice, for reasons of economy, to exchange meters on consumers' premises without exchanging the nut and liner which are left attached to the original lead connections, it was considered advisable to ensure interchangeability for the largest possible number of old unions at present on consumers' premises.

The dimensions were arrived at by gauging a considerable number of unions from various makers, and by striking the best possible compromise between interchangeability and play, bearing in mind the necessary mechanical considerations, appropriate tolerances being fixed for those dimensions affecting interchangeability. It has been found possible to make the dimensions of the nut across the flat suitable to take B.S. Spanners.

Copies of this Specification (B.S. No. 746-1937) may be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, S.W. 1, price 2s. 2d. post free.

The Manufacture of Industrial and Domestic Gases by Electricity

by A. T. STUART
(Director, Electrolytic Gas Department, Hydro-electric Power Commission, Ontario)

From a Paper presented before the Annual Convention of the Canadian Gas Association held at Ottawa.

Wherever gas is available in large quantities at low cost, as in the natural gas areas of the United States or in those areas of the United States reached by some 50,000 miles of pipe lines, gas becomes a principal fuel for industrial and domestic purposes. Probably no better evidence than this is needed to show that gas is an ideal form of fuel for many purposes.

In regions where natural gas is not available it is obviously important to investigate means for the manufacture of gas at low cost. We know that the cost of heat in bituminous coal is equivalent to natural gas at about only 15c. per 1,000 cu.ft. and to manufactured gas at about only 7·5c. The difficulty has been to convert coal to gas at low cost.

For many years it has been known and realized by experts in all parts of the world that the solution of the problem of the economical and complete conversion of coal into gas will depend upon large supplies of cheap oxygen. Air contains about 21% oxygen and air is the one and only raw material which comes to us automatically and without any cost whatever. It has been natural therefore for experts all over the world to look to air as the logical source for cheap oxygen. It is possible that this is where a mistake has been made because, in 50 years of research, no one has yet been able to procure cheap oxygen from air in moderate quantities at low costs.

One of the purposes of this Paper is to show that, in some locations and circumstances, air is not the logical source of cheap oxygen, but that water is the more logical source. One gallon of water weighing 10 lb. contains 8·88 lb. of oxygen and 1·11 lb. of hydrogen, and these two gases can be separated in the highest purity by utilizing surplus generator capacity at any central electric station, whether operated by fuel or water power, or by utilizing continuous 24 hr. water power under certain favourable circumstances. A good example of the utilization of 24 hr. water power is that of the 175,000 h.p. hydraulic plant in Norway, which has substituted power lines by pipe lines conducting away from the power house some 10,000 million cu.ft. per year of hydrogen and oxygen. Two-thirds of this volume of gas is hydrogen, which is required for fertilizer manufacture, and 3,333 million cu.ft. of oxygen are produced as a by-product at no cost whatever. This is but one example of about a dozen water power plants operated in such a manner that pure oxygen is produced in immense volumes at no cost even when primary power is used.

Certain blocks of off-peak electricity are sometimes available over a large portion of the hours of the year and are suitable for the production of hydrogen and oxygen. There are locations and circumstances where immense volumes of hydrogen could be produced at overall costs varying from about 12c. to 40c. per 1,000 cu.ft. and where pure oxygen would be a free by-product in immense volumes. If, however, costs were distributed evenly over both hydrogen and oxygen, we would have overall costs varying between 8c. and 27c. per 1,000 cu.ft. (two-thirds hydrogen and one-third oxygen).

In industry at the present time the consumption of pure hydrogen totals something like 200 billion cu.ft. per year in the production of material used in the manufacture of fertilizers, explosives, artificial silks, lacquers, soaps, edible fats, synthetic gasoline, synthetic alcohols, and other products.

In the final analysis, the principal source of hydrogen is water, whether steam is decomposed by coke or whether water is decomposed by electricity. The latter procedure has many advantages already well established in industry and it is therefore logical to expect great expansion in the process of water electrolysis. This is particularly evident when we consider that the use of hydrogen is yet in its infancy and that it yet remains to produce oxygen at low costs wherever it may be required.

The Gas Industry's Part.

In the above, reference has been made to hydrogen in a substantially pure state. There has been no reference to the fact that all gas-works are in a sense hydrogen factories in that their product contains a large percentage of hydrogen, this hydrogen coming chiefly from water consumed in the form of steam. Gas-works, of course, also consume immense quantities of oxygen originating from air and steam. Viewed in this way, the Gas Industry has always been largely a hydrogen-oxygen proposition, in spite of the fact that these materials have never been available to the Industry in their pure states.

Experts have long realized the potential advantages of having pure oxygen available and the technical literature is replete with papers and theoretical studies on the subject. Possibly the latest is presented in the 39th Annual Report of the Joint Research Committee of The Institution of Gas Engineers and Leeds University bearing the date of Nov. 4, 1936. This Committee points out that the trend of the Gas Industry is towards complete gasification of fuels by means of oxygen, and it outlines the intensive research under way in England along these lines. It also refers to the fact that, in Germany, two large companies are already using oxygen to manufacture industrial gas from lignite.

When we consider the manufacture of domestic gas, it becomes apparent that air may not be the logical source for oxygen. If we use air oxygen we produce a gas abnormally high in carbon monoxide and higher in specific gravity. If, however, we use water instead of air as the source of oxygen we restore the balance.

Electrical Complete Gasification.

The Hydro-Electric Power Commission of Ontario may claim to be among the first to demonstrate on a commercial scale how coal can be completely gasified by means of electricity for the manufacture of gas similar in composition, thermal value, and specific gravity to that now being distributed (Table II.). In this work the Commission has had the co-operation of one of the leading gas engineering firms in America.

Previously to these demonstrations many theoretical papers had been published on the subject. In general their conclusions were highly favourable towards the use of oxygen, but in one or two published papers a rather obvious theoretical error was made which led to the conclusion that oxygen would be of little value. However, with a correction of this error, the conclusions would be in line with those of other writers.

Virtually all experts concluded upon purely theoretical grounds that new apparatus and new methods would have to be developed for the use of oxygen. It was argued that some process somewhat similar to that of the blast furnace, where ash would have to be discharged as molten slag, would have to be developed and that standard gas plant equipment and ordinary temperatures could not be used. However, actual performance on a commercial scale in standard equipment has lifted the oxygen process from the realm of speculation and experiment to immediate practicability.

The Hydro-Electric Power Commission erected a plant capable of producing some 2,000 cu.ft. of oxygen and 4,000 cu.ft. of hydrogen per hour. A standard type of gas producer having stationary grates was installed for operation with oxygen and steam. The outside shell measures 5 ft. in diameter by 13 ft. 6 in. to the bottom of the fuel hopper, the grate area inside measuring 7·88 sq.ft. The best means available were incorporated for measuring the input of oxygen, steam and fuel, temperatures, pressures, gas composition, &c. Some 15 tests were made extending

over periods of 6 to 15 hours after operating conditions were stabilized.

The following tables give typical results of the gasification with oxygen and steam of (*a*) peat, (*b*) coke, (*c*) half coal and half coke, and (*d*) two-thirds coal and one-third coke. To use 100% coal it would be necessary to install a mechanical producer fitted with a fuel agitator of the Chapman type. Although these facilities were not available, the following tables include, along with actual results, a rough estimate concerning the use of 100% coal.

TABLE I.—*Gas Made with Oxygen.*

[Not Including Electrolytic Hydrogen].

Fuel.	100% Peat.	100% Coke.	50% Coal. 50% Coke.	67% Coal. 33% Coke.	100% Coal (Estimated).
B Th.U. of gas make	311	297·6	328·0	322·0	333·0
Specific gravity (approx.)	0·7	0·7	0·7	0·7	0·7
Fuel/M of gas made (lb.)	47·3	23·6	26·5	26·5	26·5
Steam/M of gas made (lb.)	16·7	17·2	15·5	15·5	16·0
Oxygen/M of gas made (cu.ft.)	184·0	219·0	207·0	174·2	170·0
Gas/lb. fuel (cu.ft.)	21·2	42·4	39·4	37·8	37·8
Cold gas efficiency, %	89·0	95·0	91·8	88·0	90·0
Approximate analysis—	%	%	%	%	
Carbon dioxide	12·7	7·6	7·4	9·7	
Illuminants	0·9	0·2	0·7	0·8	
Oxygen	0·5	0·5	0·2	0·3	
Hydrogen	35·2	31·0	32·8	36·6	
Carbon monoxide	45·6	59·9	56·2	50·0	
Methane	0·7	..	0·7	1·1	
Ethane	1·6	..	1·2	1·0	
Nitrogen	2·7	0·8	0·8	0·5	
Total	100·0	100·0	100·0	100·0	

TABLE II.—*Gas Made with Oxygen.*

[Including Electrolytic Hydrogen].

Fuel.	100% Peat.	100% Coke.	50% Coal. 50% Coke.	67% Coal. 33% Coke.	100% Coal (Estimated).
B.Th.U. of gas make	316	307	326	322	330
Specific gravity (approx.)	0·55	0·53	0·53	0·53	0·53
Fuel/M of gas made (lb.)	34·6	16·2	17·9	19·7	19·0
Steam/M of gas made (lb)	12·2	12·0	11·3	11·5	11·9
Oxygen/M of gas made (cu.ft.)	134·0	153·0	146·0	129·0	126·9
Hydrogen/M of gas made (cu.ft.)	268·0	306·0	292·0	258·0	253·8
Gas/lb. fuel (cu.ft.)	28 9	61·8	55·8	50·8	52·6
Approximate analysis—	%	%	%	%	
Carbon dioxide	9·3	5·3	5·2	7·2	
Illuminants	0·7	0·2	0·5	0·6	
Oxygen	0·4	0·3	0·1	0·2	
Hydrogen	52·7	52·1	52·5	53·0	
Carbon monoxide	33·4	41·7	39·8	37 1	
Methane	0·5	..	0·5	0·8	
Ethane	1·2	..	0·8	0·7	
Nitrogen	1·8	0·4	0·6	0·4	
Total	100·0	100·0	100·0	100·0	

Since gas was made at the rate of about 250,000 cu.ft. per day the tests were on a commercial basis and make possible the immediate introduction of the oxygen process into industry or gas-works. The quality of gas made is better than can be made in water gas sets common to the Gas Industry and vastly better than ordinary producer gas which is consumed in large quantities in steel works and other metallurgical or ceramic industries. All who witnessed the tests were impressed by the ease of continuous operation with oxygen. In fact, the oxygen blown apparatus is as easily operated as an ordinary automatic gas producer used in industry.

If it were deemed essential to put into town mains a gas having the present calorific value, specific gravity, and composition, this can be accomplished by enrichment with oil or butane. The gas shown in the right hand column of Table II. would require the incorporation of only 1½ galls. of butane in each 1,000 cu.ft. of finished gas to bring it to existing standards. This procedure shows a saving in weight of solid fuel over the common practice in water gas sets of about 57%, and much more than 57% saving in cost of solid fuel since coal is substituted for coke. Furthermore, considerably less oil or butane is required for enrichment purposes.

In the manufacture of 1,000 cu.ft. of 450 B.Th.U. gas, the cost of hydrogen and oxygen would be 10 cents with power at 2·5 mills. Coal costs add about 5c. and butane may add about 12c., so that the total costs of materials per M. of 450 B.Th.U. gas would be 27c., or 6c. per therm. If, however, we were able to eliminate enrichment and distribute 330 B.Th.U. gas on a therm basis, the materials cost with 2·5 mills. power reduces to 4·5c. per therm.

Although it is a simple matter to carburet these gases to present standards and although costs would still be less than competitive methods, the lowest possible costs would be reached if 333 B.Th.U. gas could be sold on a therm basis. It is already the practice in England and in parts of Europe and the United States to sell gas on a therm basis, and there seems to be no good reason why this procedure could not be followed in Canada.

Lowest costs for materials per therm of gas would be reached if neither enrichment nor the incorporation of electrolytic hydrogen were necessary. It has been pointed out that hydrogen has wide and rapidly expanding applications in industry at values which may yield oxygen as a by-product. The type of gas made without hydrogen is that shown in the right hand column of Table I. (333 B.Th.U.). With oxygen at no cost, the cost of materials (coal) would reduce to 2·1c. per therm, or only 7c. per 1,000 cu.ft.

With regard to the use of existing gas-works equipment, the gas producers now used for heating retorts and ovens might be used instead to manufacture gas for distribution. Similarly, water gas sets might be adapted for complete gasification of coal by means of oxygen. With regard to vertical retorts, Hodsman and Cobb (England), some years ago, suggested the use of oxygen and steam to fire retorts internally, to increase the gas make and to control the output of coke, as desired. Probably, similar procedure might also be used in coke ovens, with or without the use of oil for enrichment purposes.

When we reflect that gas of these types can be made in automatic gas producers at rates of from 75,600 (Table I.) to 105,200 (Table II.) cu.ft. per ton of coal and that a single producer may have a capacity of up to perhaps 5 million cu.ft. per day, it becomes evident that cheap oxygen is capable of effecting a complete revolution in gas manufacture for both industrial and domestic purposes.

The Future.

Probably it was something like this which Mr. Charles A. Munroe, President of the American Gas Association for 1921, had in mind when he stated before the Technical Section at the 1921 A.G.A. Convention:

> "Some of you gentlemen are going to be able to give us a gas from raw coal of 420 B.Th.U., and we are going to have no by-products to handle or sell, nothing but ashes to take away from the coal. When you give that to us then the problem of the owner of a gas company will be much simpler than it is to-day, when he must make coal gas with an enormous quantity of coke left as residue, which puts him into a business of a larger dollar and cents annual turn-over than his gas business. . . . What we want is to have a plant that will enable us to put coal in and take gas out and leave nothing but cinders."

Similarly, the 39th Report of the Joint Research Committee of The Institution of Gas Engineers and Leeds University may be quoted:

> "When the Gas Industry seeks expansion by supplying gaseous fuel where solid fuel has hitherto been employed, the production of solid fuel in quantity at gas-works may well prove an embarrassment. . . . The probable future trend of the Gas Industry's business is the complete conversion of coal into gas . . . preferably made by continuous gasification with oxygen."

These British authorities have recognized the fact that oxygen derived from air by liquification would produce a gas abnormally high in carbon monoxide, and they therefore propose to subject the gas made with oxygen to a process of catalysis, so as to yield gas containing much less carbon monoxide and a considerable quantity of methane, the final product not being greatly dissimilar from coal gas.

The present writer has emphasized in this Paper how this complex secondary processing can be circumvented and how complete gasification can be introduced immediately even into small gas-works. This is accomplished by utilizing electrolytic hydrogen and electrolytic oxygen (in place of air oxygen only) to produce gas of normal carbon monoxide content and having the present standards of B.Th.U. value, specific gravity, and composition without any complex secondary processing.

Internal Inspection of Water-Sealed Gasholders

by
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A Paper presented to the A.G.A. Joint Committee Conference of the Production and Chemical Committees.

The policy of making internal inspections of water-sealed gasholders every 25 years has been receiving considerable attention lately, not only from gas engineers but also from public authorities having proper jurisdiction. The Department of Public Service, of the State of New York, gave consideration to the subject of holder inspection which resulted in the issue in 1935 of Rules and Regulations for the inspection of gasholders and included a provision for internal inspection "... after a period of continuous service not to exceed 25 years ..." In a situation where there is no legal requirement, at least one gas company has adopted the procedure as a matter of good policy.

It is to be emphasized that internal inspections which are the subject of this Paper are not inspections made because of some known fault in the condition of the holder, but are made on principle after a certain period of use.

As it is impossible, while a holder is in service, to observe its various internal parts, such as the permanent frame, cup rollers, and tank bottom, periodical internal inspections seem very advisable. It is not to be assumed that 25-year periods are the most desirable, but that interval seems to be generally accepted at this time. Experience will be necessary for better judgment as to the interval between inspections. Where the lightest sheets in the holder are not less than No. 11 iron (B.W.G.), 25 years probably is a safe period with which to start unless the water or the gas is unusually corrosive.

It would lead to an interesting discussion to consider the extent to which a holder may deteriorate before it can be detected externally. Certainly the condition of the permanent frame, of the usual wood construction, cannot even be guessed until it has reached a dangerous extent from floating or dislodged timbers. There are other parts of the holder, however, of which we normally think as being inaccessible where a certain amount of examination can be made from the outside without putting the holder out of service. For example, if a hole about 1¼ in. in diameter is drilled in the grip channel above a bottom roller, a specially constructed light can be inserted and a fair observation of the roller and shoe obtained. A piece of glass placed on the hole and sealed with putty will facilitate the operation. There has been placed on the market a device somewhat similar to a bronchoscope which can be inserted through a hole to make examinations of the rollers and the internal stiffeners. Specimens can be cut from the metal of the shell when the holder is in service so that much of the condition of the holder can be ascertained while it is in service. The permanent frame for new holders might be redesigned in steel so that possibly more assurance of its lasting good condition could be had than the present ones of wood construction. These considerations, to some extent, tend to minimize the number of reasons for periodic internal inspections.

Disposal of Water.

When an internal inspection is to be made the disposal of the gas-impregnated water from the holder tank or pit presents a problem. If this is to be emptied into the city sewers, care must be exercised to guard against the formation of an explosive mixture in the sewers and, where the holder is situated in a built-up neighbourhood, odours escaping from the sewer manholes can be the cause of annoyance to neighbours. Aeration or partial degasification of the water as it is pumped or syphoned from the holder is very helpful and necessary under many conditions.

The extent of water degasification should be considered as that which is necessary to prevent the formation of an explosive mixture in the sewer, to avoid complaints, and to prevent stream pollution.

In Philadelphia, during the last three years we have made internal inspections of four tank holders and two pit holders of the water-sealed type. In the degasification of the water from two outlying holders, containing 6,250,000 galls. of water each, the apparatus used consisted of a scrubber 22 ft. high, 5·5 ft. in diameter, filled with wooden grids to a depth of about 17 ft. A centrifugal pump delivered 20,000 galls. of water per hour from the holder through sprays into the top of the scrubber, the water discharging into a drain at the base of the scrubber and thence to the sewer. A fan-type blower having a capacity of 1,300 cu.ft. per minute was used to blow air into the base of the scrubber passing upward through the wooden grids in a direction counter to that of the water. The mixture of air and gas leaving the tower passed into an 8 in. galvanized flue pipe extending to the top of the guideframe, a distance of 175 ft. above the ground.

Some tests showed that with a water temperature of 47° leaving the holder with no aeration whatsoever, the explosiveness of the atmosphere in the sewer 200 ft. from the holder was 35% in the low limit and in the drain leading to the sewer, at the holder, 55% of the low limit. As city sewers are usually much warmer than 47°, we believe that a dangerous amount of gas will be given up in the sewer if the water leaving the holder is not aerated. The above test was made with 350 galls. per minute discharging into a 3 ft. by 2 ft. sewer. If, however, 5 cu.ft. of air per gallon of water is blown into a tower, as described above, there will not be sufficient gas left in the water to form an explosive mixture in the sewer, based on many tests made through sewer manholes, at various points in the sewer and along its entire route to the river. If there is an abundance of water flowing in the sewer from sources other than the holder and the water containing gas from the holder has been aerated in the method described, not only will there be an absence of an explosive mixture, but there will probably be no odours escaping from the manholes. If, on the other hand, there is practically no water from other sources in the sewer there will be an objectionable smell because of the odoriferous material not removed by the aeration process, but there is not likely to be an explosive mixture.

The results of many tests while using the 5 to 1 ratio show that the highest point of explosiveness in the sewer was 4% of the low limit and in the top of the scrubbing tower it was about 6%. The apparatus described met all requirements in Philadelphia. However, local ordinance may demand more complete scrubbing and treatment than this procedure.

Ventilation of Holder.

The American Gas Association in its recommendations for purging holders requires that some of the crown sheets of the holder should be removed for ventilation as soon as the holder is purged. Should the holder be located in a residential area it may be desirable to ventilate in some other manner so as to avoid spreading an offensive odour. In one such case this was accomplished by blowing air into the inlet of the holder, venting it on the opposite side through a light galvanized iron vent pipe which carried the fouled air to the top of the guideframe where it was dissipated without offence. A combustion gas indicator was used as a guide for the quantity of air required. It was found that 30,000 cu.ft. of air per hour was ample. This method of ventilation was effective until the bottom curb unsealed, when strong odours came from under the lifts. Fortunately, this condition was of short duration. Forced ventilation was then discontinued and crown plates removed.

Before men enter the holder to do any work, two men should be sent inside with respirators to take samples of the atmosphere in various sections of the holder for test in approved apparatus for the detection of very small quantities of carbon monoxide.

In holders that have been in long service, there is always a collection of dirt and muck which settles to the bottom of the tank. This should be entirely removed for proper inspection of the bottom plates. Likewise all such material should be removed from under the cups, so that a complete inspection can be made of the bottom rollers.

The cups can be drained by removing several bolts which hold the bottom roller shoes to the cup. All dirt should be removed and foreign matter scraped from the cup sheet and the bottom sheet of the lifts.

After the holder has been physically disconnected and before the water is removed, observation should be made for leakage into the inlet and outlet risers. If any repairs are made, it is well to test these pipes again before the holder is put in service.

Only competent gas engineers should be placed in charge

of holder inspection. In addition, it is advisable to employ a reputable holder builder for such an examination as a check on the inspection of the gas company's engineer and to gain the benefit of their long experience in these matters. Such additional inspection by outside experts may prove of value as a matter of record.

Corrosion in Cups.

The need for a painstaking inspection of the cups cannot be emphasized too much. On one of the Philadelphia holders recently extensive pitting was found near the toe of the channel on both sides of the top cup. The other two cups were in good condition. As most of these pits were filled flush with the surface with rust, they would probably have been missed if the inspection had been casual and the light poor. In fact, only one or two places were found on the first tour of inspection, but a more thorough inspection revealed 21 areas with pits, the deepest of which was $\frac{1}{8}$ in. It seemed advisable to reinforce these areas with $\frac{1}{4}$ in. plates bolted on. These plates varied in size from 5 in. by 5 in. to 13 in. by 36 in. In addition, 18 single pits were found and were mended by drilling through the plate and refilling the hole with a grommetted bolt.

In a number of cases it was necessary to place the patch on the outside of the cup sheet since the pitted areas ran so close to the toe of the cup channel that the rivets securing them to the cup sheet were necessarily removed to provide the bottom row of bolt holes for the patch. In all cases where bolts were passed through the channel, bevelled washers were employed so as to have an even pull on the bolt.

This holder is situated close to a main line railroad from which considerable soot was deposited on the crown and from there washed into the top cup. Although the cups were cleaned frequently while in service, the soot piled up behind the grip sheet where it could not be removed readily.

It would seem that the presence of sulphur bearing material from the railroad was the cause of this corrosion. I would like to point out that this corrosion formed a hard filling in the pits and powdered as it was scraped out. It bore no resemblance to the laminated structure of iron oxide usually found where the iron is exposed to the air. It is hard to conceive why this corrosion took place in certain spots in the same bay and was not continuous all along the bay unless the paint was destroyed in spots and the corrosion thus localized. This is mentioned now as food for thought in future discussions as to the nature of the protecting film to be used in covering the bare metal below the water line in the cups. The occurrence of local pitting is more detrimental and penetrates deeper than does rusting of the entire area of the sheet involved. This condition has been found in the cups of other holders, about 4 in. below the normal water level in the cups, or about the point where routine painting of the holder cups ended.

Internal and External Stiffeners.

The internal stiffeners are usually fastened to angle irons which in turn are attached to the shell by widely spaced rivets. It may be well to remove some of these angles to determine the extent to which corrosion has progressed and weakened the side sheets. This corrosion is invariably found and, if allowed to continue, may cause a cracking of the shell at these points by the pressure exerted through expansion in the formation of iron oxide assisted by the internal gas pressure on a side sheet that has become very thin.

Some older holders have external channel-iron stiffeners which are fastened to the shell with the web outside, forming a box-like structure, making the shell and the inner surfaces of the channel inaccessible for painting. Experience has shown that these should be removed and the shell reinforced by some other method, if necessary.

In the case of a 2,500,000 cu.ft. holder, 34 years of age, the external channel-iron stiffeners were in very poor condition, and they were removed and plates 0·134 in. in thickness were welded to the shell to cover the weakened areas which in some places were rusted almost through.

Crown.

There are no doubt a number of holders still in existence that have trussed crowns. The top members of these trusses are made of tee irons fastened to the crown by widely spaced rivets, promoting crown failure by rust formation between the crown plates and the truss. Experience has borne out the importance of careful inspection of trussed crowns, particularly for very old holders of light weight metal.

The testing of holder plating, by the removal of specimens in the crown or side sheets, should surely be done at the time of inspection if it has not been done in recent years.

Tank Rails and Landing Blocks.

The tank guide rails and the adjustment bolts used in plumbing and fastening the rails to the tank should be inspected for corrosion and tightness of bolts. All tank rails should be checked and made plumb.

Landing blocks not securely fastened to the bottom of the tank may shift their position. Tack welding will stop such movement.

The levels of the landing beams should be checked. This is best accomplished by sighting with a Y-level on the inner ends of the blocks and then using a spirit level to determine the slope of each individual block. If any block is sufficiently higher or lower than the adjacent blocks so that it can be judged that the lifts are unduly strained, filler pieces should be placed on the low blocks and tack welded in position. The lifts can usually be raised by the careful manipulation of jacks, but it should be recognized that the operation presents some difficulty and should be limited in extent to that which seems really necessary.

The permanent frame should be examined immediately upon entering the holder for loose timbers that might fall on a workman. After the woodwork has thoroughly dried, the permanent frame should be examined carefully to note the condition of the wood and how securely the members of this frame are fastened together. Several instances have been found in Philadelphia where, due to the enlargement of the nail holes, cross braces have fallen from the frame. The bolting and strapping of the permanent frame members should be carried out in keeping with present-day practice and wherever expedient.

A number of internal rollers are often found frozen to their shafts or have dropped from the shoe underneath the cup. It will probably be found necessary to remove the entire shoe from the cup before a roller can be made to ride free on the shaft. It is obvious that lost rollers should be restored and placed in proper adjustment. Conscientious workmen are needed to do this work, which is done under conditions usually not the most pleasant.

Miscellaneous.

Tools, pieces of wrought iron pipe, and other foreign articles inadvertently dropped into the holder tank or pit have been found lying on top of the land blocks, and in one instance a full length of 3 in. pipe was so badly locked under the outer lift angle iron that it could not be removed by jacking up the lifts locally, so a piece of rope was securely tied to this pipe until the holder was again inflated, when the pipe could be lifted up. This is simply mentioned as among the things to look for in rather hidden parts of a holder.

Any major work that may be found advisable on the goosenecks or guideframe can be done to advantage while the holder is out of service. Likewise during the period the tank is empty, opportunity is afforded for re-riveting or caulking leaky rivets and seams in the shell and tank. We might take time to emphasize the importance of marking points of leakage, both gas and water, with paint before the holder is put out of service, as trusting to memory will not prove successful.

An inspection of the inside of the grips should be made, and if their condition warrants it, they should be cleaned. Whether the grips should be painted is a question on which all gas men may not agree. An examination should be made of the sounding pipes and drip pump castings.

Before the holder is closed up, all cups should be filled with water and careful measurements taken of the water level in the cups which would indicate large leaks and a careful examination made underneath the cups for small leaks.

We should not rush to a conclusion in this matter, but take sufficient time to be positive that all the cups are tight, otherwise much inconvenience may be experienced.

Restoring to Service.

After the inspection has been completed and all repairs made, a careful search should be made of the cups and tank bottom for tools, lumber, and any loose articles that have been left behind. This cannot be done too carefully, especially in regard to the cups, as bars, wrenches, and other tools may cause serious damage when the cup engages its respective grip. After inspection and refilling the tank with water, the holder should be inflated with air at least once before purging. This is particularly important when any roller adjustments have been made that might change the clearances in the cups.

If the holder has not been used in the inner section be-

cause of its being too light to meet the required distribution pressure or for other reasons, such a holder should be watched carefully as it is being inflated with air to give assurance of proper cupping, as the inner lift when riding alone is most unstable and is kept plumb only by proper roller adjustment.

From the writer's experience with conditions found on the inside of 20 holders, during the last 20 years, it is my firm conviction that all holders should be internally inspected at least every 25 years, if for no other reason than to inspect the permanent frame. There are cases on record where the permanent frame has been in a state of collapse when the holder has been opened and where a tank bottom has been very badly eaten away. These failures cannot be ascertained without making an internal inspection.

Determining Hourly Gas Input Rates

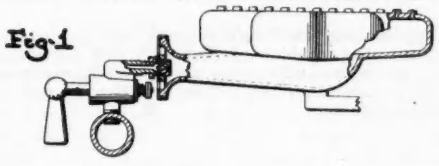
Contributed by

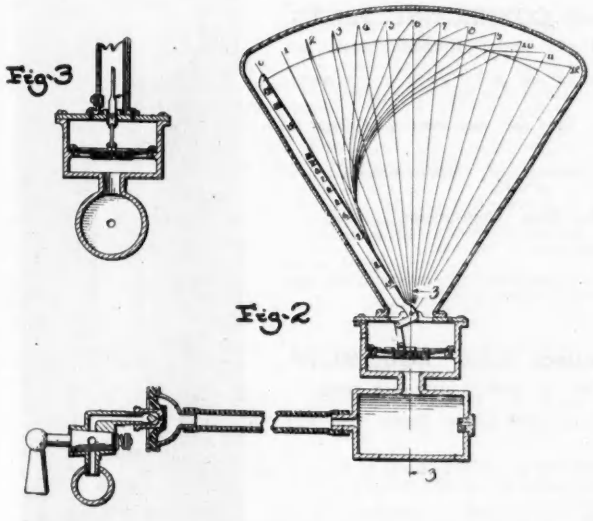
F. O. SUFFRON,

Supervisor, Pacific Coast Branch,
A.G.A. Testing Laboratories

The Author has undertaken the development of a portable instrument capable of indicating quickly and conveniently the rate of gas flow through an orifice without reference to displacement meter readings.

In recent years, the Gas Industry has expended considerable effort in research and development activities undertaken to improve the efficiency, safety, and general overall performance of all gas burning appliances. In general, results of these activities have been gratifying, and, as a consequence, contemporary gas appliances are capable of delivering much better service than their predecessors. It has become increasingly important, however, that these new improved models be accurately adjusted on the district in order that their superior performance may be fully capitalized. An essential part of such district adjustment is to ensure the proper B.Th.U. input rate to the burners. Generally speaking, any appliance will deliver its maximum output consistent with optimum efficiency and safety at the manufacturer's approved specified input rating, and it should, obviously, be adjusted to this particular rate for best performance.





Adequate steps have been taken in many situations to ensure proper adjustment of gas burners. In the case of certain gas utilities, for example, appliances are adjusted to the correct gas rate by means of displacement meters on the district, or in the shop prior to installation. In other cases certain expedients are resorted to in order to obtain an approximately correct adjustment, as, for example, by comparing visually, the burner being adjusted to a similar burner which has previously been adjusted by a meter and which is used as a standard. However, in a great many instances, adjustments of appliances are made visually because a meter adjustment would not be convenient or feasible. It seems reasonable to conclude that if an inexpensive portable flow meter of suitable accuracy were available, it would be employed quite widely for appliance adjustment services, and might even be substituted for displacement meters in the interest of more rapid and convenient district adjustments.

In order to satisfy this need, the writer undertook the development of a portable instrument which could be easily carried by a fitter and which would be capable of indicating quickly and conveniently the rate of gas flow through an orifice without reference to displacement meter readings. The principle embodied in the instrument which has been developed is, it is believed, new in the art of gas flow measurement. It deals fundamentally with the determination of the gas flow from an orifice (orifice on the appliance) in terms of another calibrated orifice or orifice of known flow characteristics connected in series with the appliance orifice.

The principle involved in this development is illustrated by the patent drawings shown as figs. 1 to 3, inclusive, and by the schematic sketch of fig. 4. As will be noted from the latter figure, a calibrated orifice (A_2) is installed as the outlet of a suitable chamber designed to reduce the velocity head of the flow stream to an insignificant amount. Connection is made from this chamber to the appliance orifice, and a means is provided for attachment of a convenient pressure gauge to the chamber of the device. A "U" gauge of the type shown in fig. 4 is adequate if mathematical calculations are to be used in determining the rate of flow from the appliance orifice.

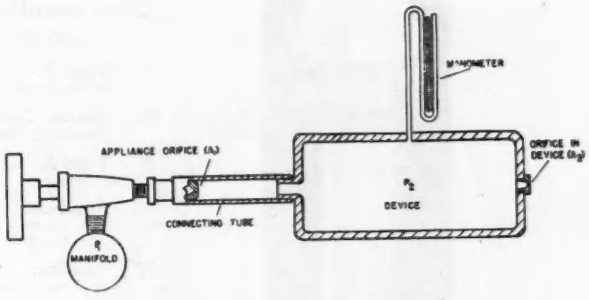


Fig. 4.—Flow Measuring Device.

The principle of operation of this device is premised on the accepted equation governing the flow of gas through an orifice which may be stated as follows:

$$Q = 1{,}658{\cdot}5\ KA\sqrt{\frac{P}{d}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Where:

Q = flow of gas through orifice, cu.ft. per hour.
K = co-efficient of discharge through orifice.
A = area of orifice, sq.in.
P = gas pressure at orifice, inches of water gauge, and
D = specific gravity of gas (air = 1·0).

The mathematical development of the problem may be made through expansions of this basic formula for flow of

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with the

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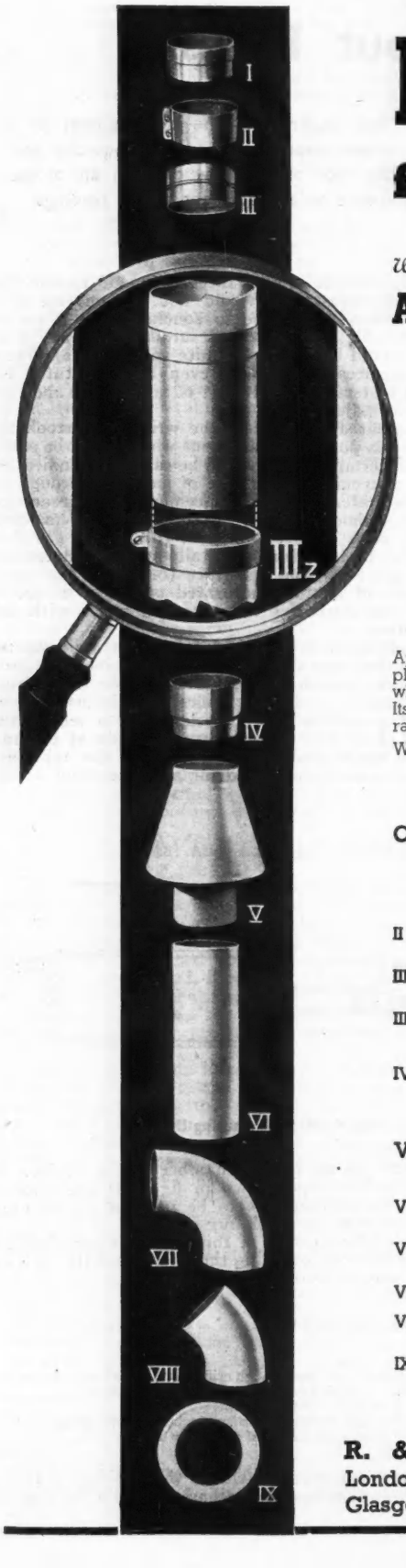
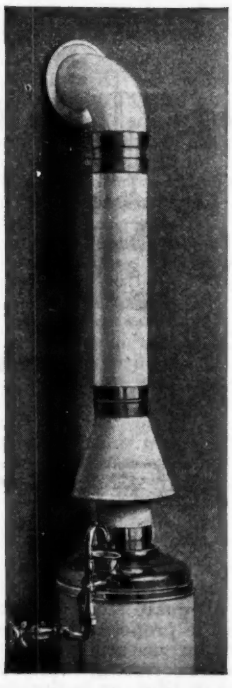


This unit obviates entirely the necessity of cutting vitreous-enamelled flue piping where an odd length is required. Thus one of the chief difficulties of fitting flue equipment can be easily overcome.

This fitting consists of two parts (see illustration in circle): one being a 7″ sliding sleeve with a socket at one end to receive the upper flue member, and at the other end a spigot which is inserted into the lower flue member. The other part is a collar which is fitted over the lower flue member. When the screw on this collar is tightened it grips the sliding sleeve and holds it in the desired position.

Apart from its really attractive appearance, this flue equipmen with its chromium plated connecting pieces eliminates the troubles of corrosion and discoloration which have previously been experienced with other types of flue equipment. Its permanence and the ease with which it may be cleaned are features which are rapidly being appreciated by gas consumers.

Write for descriptive literature



Chromium-Plated CONNECTING PIECES

In 3″, 3½″, 4″, 4½″ and 5″ diameter sizes.

Type B. A Spigot and Socket Piece for connecting the flue member to the primary flue of geyser, etc.

II **Cover Clip.** Used in conjunction with Type B Connecting Piece.

III **Type A.** For connecting all vitreous-enamelled flue members.

IIIz **Adjustable Flue Pipe Connection.** Its employment removes the necessity of cutting a vitreous-enamelled pipe where an odd length is required.

IV **Adaptor.** For connecting vitreous-enamelled flue equipment to asbestos-cement flue pipes.

Vitreous-Enamelled FLUE EQUIPMENT

In 3″, 3½″, 4″, 4½″ and 5″ diameter sizes.

V **Baffler.** G.L.C. Improved Conical Pattern. Pat. No. 305809/29.

VI **Flue Pipe.** Supplied in standard lengths of 6″, 12″, 18″ and 24″. Other lengths can be made to order.

VII **90° Plain Bend.** Also available in corrugated pattern.

VIII **Obtuse Plain Bend.** Also available in corrugated pattern.

IX **Ceiling or Wall Plate.**

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gas through an orifice, using the following symbols for the characteristics of the system:

P_1 = gas pressure (static) in manifold, inches of water.
P_2 = gas pressure (static) in device with A_2 open, inches of water,
A_1 = area of orifice in manifold, sq in.
A_2 = area of orifice in device, sq.in.
Q_1 = flow through orifice A_1, without device in place, cu ft. per hour.
Q_2 = flow through orifice A_1 or A_2 with device in place, cu.ft. per hour.
K_1 = co-efficient of discharge of orifice A_1.
K_2 = co-efficient of discharge of orifice A_2.
d = specific gravity of gas (air = 1).
H = heating value of gas, B.Th.U. per cu.ft., and
I_1 = rate of flow of gas, B.Th.U. per hour (Q_1H).

There are two conditions of flow possible of solution—namely:

a. When gas is passing through orifice A_1 without the device in place. This condition is the one desired, and the applicable form of equation (1) is:

$$Q_1 = 1{,}658{\cdot}5\ K_1A_1\sqrt{\frac{P_1}{d}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

b. When the gas is flowing through both orifices with the device in place. Under this condition it is evident that the rates of gas flow through orifices A_1 and A_2 are identical. Two forms of equation (1) may be written, therefore, for this condition of flow as follows:

$$Q_2 = 1{,}658{\cdot}5\ K_2A_2\sqrt{\frac{P_2}{d}}, \text{ or} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$Q_2 = 1{,}658{\cdot}5\ K_1A_1\sqrt{\frac{P_1 - P_2}{d}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

In equation (2) K_1 and A_1 are generally unknown or cannot be determined readily. Therefore, they must be replaced by known terms. Equation (4) may be solved for K_1A_1 and this value substituted in equation (2), or

$$Q_1 = Q_2\sqrt{\frac{P_1}{P_1 - P_2}}$$

This introduces the unknown quantity, Q_2, which may be eliminated by substituting its value as given in equation (3), or

$$Q_1 = 1{,}658{\cdot}5\ K_2A_2\sqrt{\frac{P_1P_2}{(P_1 - P_2)\,d}} \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Equation (5) is that governing the flow conditions involved in operation of the device and that which permits calculation of the flow of gas through an orifice of unknown size and characteristics in terms of readily ascertainable variables. In analyzing this equation it will be seen that the flow of gas through the appliance orifice (Q_1) under normal conditions—that is, without the device in place—is expressed as a function of five variables, K_2, A_2, P_1, P_2, and d. The coefficient of discharge of the orifice in the device (K_2) may be calibrated. The area of the orifice in the device (A_2) will, of course, be known from the drill size employed, provided reasonable care is exercised in drilling the orifice. The pressure in the device P_1 may be observed with the device in place and with gas flowing. The pressure in the manifold before the appliance orifice may be also observed on the manometer (fig. 4) by the simple expedient of placing a finger over, or otherwise closing off, the orifice in the device. The specific gravity of the gas (d) is generally a known characteristic of the gas in any particular community.

While the form of device shown in fig. 4 is probably the least complex application of the principle discussed herein, the fact that its use would require rather complicated calculations or reference to tables or charts renders it less convenient than would be desirable. A more convenient application seems to be a direct reading chart, as illustrated in fig. 5.

For construction of such a chart equation (5) may be modified to more convenient forms by solving it for (P_2), or

$$P_2 = \frac{Q_1^2}{\frac{(1\,666\ K_2A_2)^2}{d} + \frac{Q_1^2}{P_1}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

where readings in cubic feet per hour are desired, or

$$P_2 = \frac{I_1^2}{\frac{(1{,}666\ K_2A_2H)^2}{d} + \frac{I_1^2}{P_1}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

where flow results will be in terms of B.Th.U. per hour.

The procedure followed in constructing a suitable chart is illustrated by fig. 5 and the following discussion. It should be evident that the device actuating mechanism for the type of chart indicated must be such as to give an arm movement which is proportional to gas pressures in the device chamber throughout the range of the chart. The diaphragm actuating mechanism illustrated in figs. 2 and 3 is an example of a mechanical linkage that will serve this purpose. With such a mechanism the base pressure lines (straight) as shown are equal divisions on the chart (fig. 5) and are designated in any convenient unit (inches of water, for example, to be consistent with equations (6) and (7)), and are, of course, indicative accurately of static

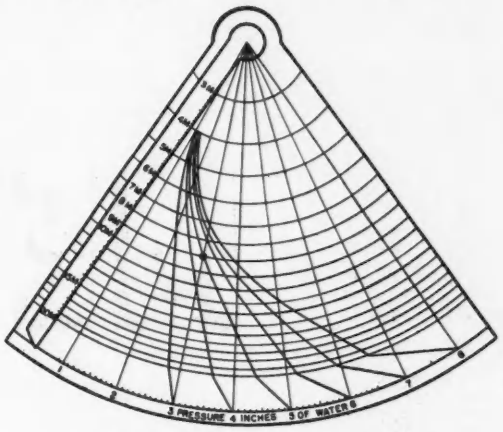


Fig. 5.—Sample Direct Reading Chart.

gas pressure in the device. The arm is divided into any convenient scale, logarithmic being recommended as generally providing the most legible curves. The range of units on the arm must obviously encompass the range of flows to be encountered and the units for this example will be given in B.Th.U. per hour.

With an arm of suitable length and having suitable divisions, the construction of the curved lines may be accomplished graphically. With the centre of the arm as a focal point arcs of circles having radii the same as corresponding flow rates on the arm may be inscribed on the chart. Predetermined value of flow (I_1) and values for K_2, A_2, H, P_1, and d in equation (7) are then selected and solution made for P_2. For example, if

I_1 = 9,000 B.Th.U. per hour.
K_2 = 0·815.
A_2 = No. 56 D.M.S. (0·001698 sq.in.).
H = 1,100 B.Th.U.per cu.ft.
d = 0·60.
P_1 = 5·0 inches of water.

then P_2 = 3·018 in. Thus, a point is made at the intersection of the radial pressure line "3·018 in" and the arc

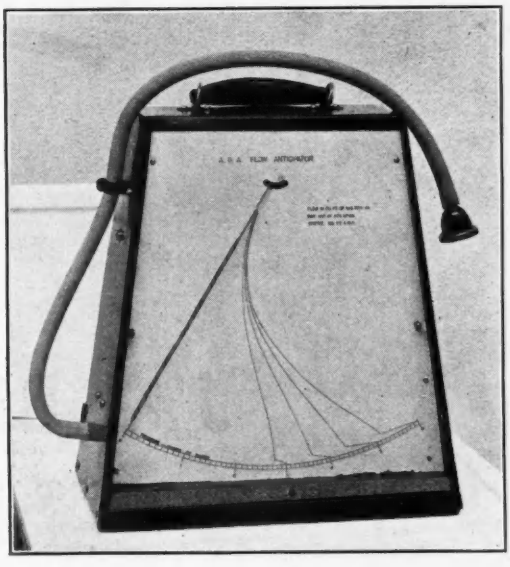
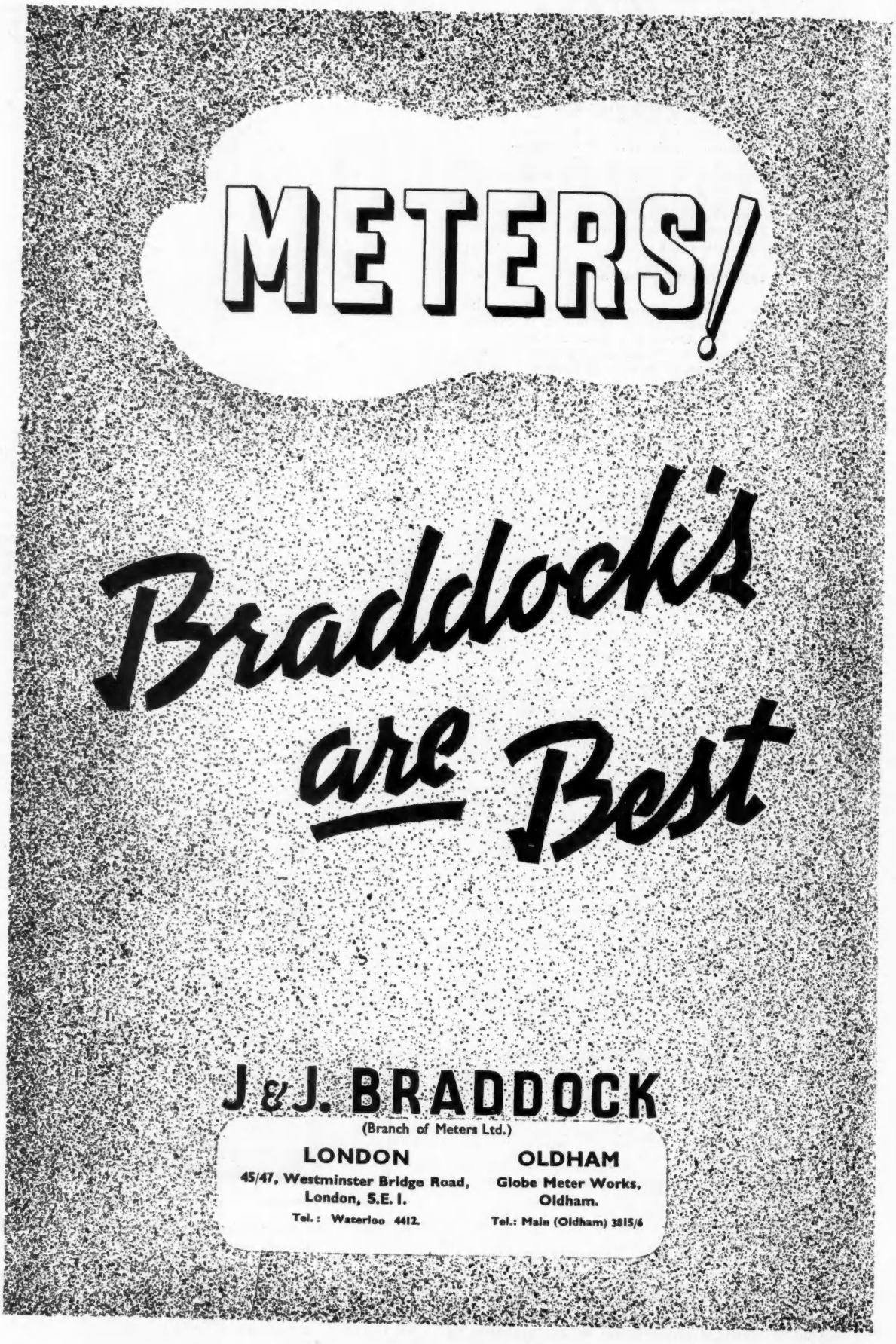


Fig. 6.—Portable Meter Embodying Diaphragm Pressure Indicating Element and Direct Reading Chart.

identified with 9,000 B.Th.U. per hour ("9M" on arm) on the chart (point indicated in fig. 5 by circle). Similarly, other points are determined by substituting other values for I_1 and P_1 in equation (7) and solving for P_2. A tabula-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tion of the results obtained by these calculations could be used in conjunction with the simple manometer-form of the device.

Errors introduced in the measurement of fluid flow by this method are for the most part small if proper care is taken in the selection of a sensitive gauge and an accurately drilled orifice (A_2). Orifice co-efficients of discharge vary with the types of orifices and will depend on the angle of approach, length of channel, drill size, pressure, and throughput. Each orifice should, therefore, be calibrated for precise work. The orifice should be accurately drilled so as to permit accurate determination of its area. Errors attributable to the orifice are controllable and with proper workmanship should not be appreciable.

Manifold pressure can be most conveniently measured under static (no flow) conditions as described in a preceding paragraph, since there is usually no ready means of making this measurement under normal flow conditions. It is evident that the manifold pressure may be measurably lower with flow than under static conditions, due to friction losses in piping and controls. Moreover, the manifold pressure would be less without the device in place (Q_1 flow) than with the device in position (Q_2 flow). The magnitude of error introduced would, of course, be variable. The total error found during experimental work in the development of the instrument has not exceeded 2%.

The instrument may be used either to determine the existing rate of gas flow to a burner or to adjust the flow to some desired rate. The fitter first removes the burner exposing the orifice fitting and then attaches a flexible tube equipped with a suitable connection to the orifice hood, as shown in figs. 1 and 2, closes the calibrated orifice at the outlet of the device chamber, and opens the gas valve admitting manifold pressure to the pressure gauge. Thus, the manifold pressure is established and the selection of the appropriate pressure line on the chart may be made. Next, gas is permitted to flow through the system with a consequent drop in the static pressure in the chamber. The observer follows the selected manifold pressure line until it is intersected by the calibrated needle. At this point a reading is made, which indicates the flow which would exist through the orifice of the appliance without the device in place. Adjustments of the orifice to obtain desired flows can usually be made without detaching the instrument.

It is conceivable that other arrangements of this principle may be devised for convenience in operation, the applications disclosed herein being of an illustrative nature only. For example, it would be possible to construct an instrument which would operate a signal, such as a light or a bell, when a predetermined pressure was reached in the chamber of the device. It should also be evident that other types of charts and pressure indicating or recording elements governed by the principle evolved could be employed.

W.G.C. Branch Visits Gas-Works

The above photograph shows members of the Bradford Branch of the Women's Gas Council on the tank balcony and staircase of the new 2¼ million cu.ft. spiral-guided gasholder now in course of construction at the Birkshall Works by Messrs. Clayton, Son, & Co., Ltd., of Leeds. The visit was made on July 22.

Athletic and Social

British Thermostat Social and Sports Club.

On June 26 the Social and Sports Club of the British Thermostat Company enjoyed a highly successful outing to Southend-on-Sea, where during the course of a full day they were entertained at lunch to the number of 350 by the Directors of the Company. During lunch the Club Chairman, Mr. W. F. F. Martin-Hurst, introduced the new Chairman of the Company, Col. N. Hudson.

Newcastle Employees Visit London.

A trip to London was enjoyed last week by 400 members of the Newcastle and Gateshead Gas Company Welfare Club and friends, when the programme included a visit to the Smithfield and Covent Garden Markets and Windsor.

Showrooms Specializing in Hot Water

Blackpool Campaign

The accompanying photograph indicates how Maxol Heaters, Ltd., assisted the Blackpool Gas Department in the spring campaign. A temporary showroom was opened in one of Blackpool's busiest thoroughfares and completely equipped with a full range of hot water appliances. In order that comprehensive demonstrations could be carried out for interested consumers, a complete hot water section occupying the full length of one wall was installed and connected to gas and water. Consumers were able to see at a glance which of the various heaters best suited their purpose. The showroom windows presented a galaxy of chromium, and the amount of attention these attracted was sufficient justification of the policy employed. In support of the showrooms, and working in

conjunction, was a team of salesmen who in the course of three months visited almost every house, boarding house, and hotel in the town. Consumers were acquainted of the intended visit of the salesmen and invited to look in at the showroom and partake of light refreshment, free of charge, while examining the appliances.

Gas Undertakings' Results

Alloa.

The annual report of the Alloa Gas Department for the year ended May 15, 1937, includes for the first time the supply of gas to Alva. On the expenditure side, coal cost £20,119; maintainance of works and plant, £5,955; repairs to pipes, meters, and cookers, £4,571; taxes, £6,002; superannuation, £664; and, with other charges, the total was £45,602. Sales of gas amounted to £43,983; receipts from residuals totalled £14,677, being 73% of the cost of coal. The total revenue amounted to £59,509, and the gross profit on the year's working, £13,907. After meeting payments to the sinking fund, interest on loans, and income-tax, the net profit amounted to £3,391. The quantity of gas sold was 271 million cu.ft., an increase of 42 million cu.ft. compared with the previous year. Of this amount Alva was responsible for 38½ million cu.ft.

Auchterarder.

The Directors of the Auchterarder Gas Light Company have declared a dividend of 6%, less tax, after providing an increased sum for depreciation as compared with the previous year, and carrying forward a substantial balance to next year. The erection of a new showroom and office accommodation has been begun.

Bo'ness.

The annual report of Bo'ness Gas Light Company shows that the sale of gas during the past year increased by almost 1 million cu.ft., and that there was also an upward tendency in the receipts from residuals. The income for the year amounted to £10,908 and the expenditure to £9,196, leaving a balance of £1,712.

Chelmsford.

The annual report of the Engineer and Manager of the Chelmsford Gas Department, Mr. F. N. Howes, for the year ended March 31, 1937, states that gas sales have continued to expand and the increase in production of 19¼ million cu.ft. is the largest for any year in the history of the Department. This was equivalent to 7½%, or the same amount of increase as in the previous year. During the year 505 consumers were added to the Undertaking's books. The average consumption per consumer has remained practically constant. In spite of a small increase in price of coke the demand has continued to exceed the supply. The amount of business at the showrooms continues to increase. During the year sales of apparatus amounted to £11,852 in value against £9,583 last year. Approximately 3½ miles of distribution mains were laid during the year, varying in size from 3 in. to 12 in. in diameter. The gross profit for the year amounts to £17,607. After making provision for loan repayment, interest, income-tax, &c., and crediting Unemployment Grants received, the net profit is £124 as compared with £2,557 for the previous year. The total expenditure on revenue account is £48,216, compared with £41,847 in 1935-36, an increase of £6,369. This increase arises under several headings, the two most important being coal and rates. With regard to coal, apart from the increase in cost due to the larger quantity carbonized, contract prices were considerably higher than in 1935-36, with the result that the average cost was 1s. 6d. per ton more than for the previous year.

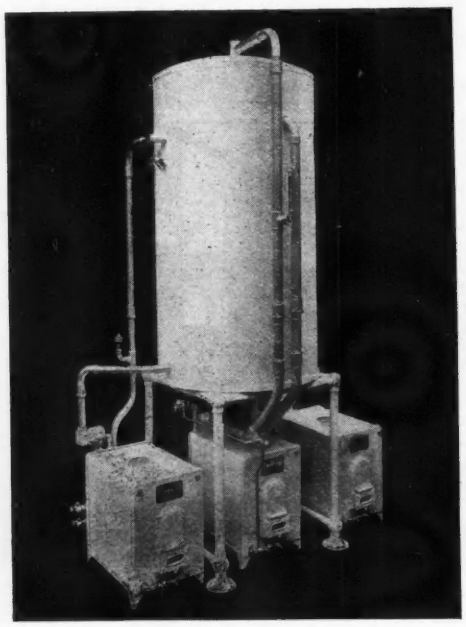
Cupar.

The Cupar Gas Company report that since electricity was introduced into the burgh gas sales have risen by 10 million cu.ft., last year's sales being 55,354,000 cu.ft., an increase of 650,000 cu.ft. over the previous year and 3 million cu.ft. more than two years ago. The price of gas will remain unchanged.

Dunfermline.

The annual report of the Engineer and Manager of the Dunfermline Gas Department, Mr. J. Campbell, states that for the year ended May 15, 1937, the income amounted to £85,992, and the expenditure to £67,345, leaving a gross profit of £18,647, to which had to be added Unemployment Grants amounting to £651, making a total credit of £19,299. From this sum there falls to be deducted repayment of loans, £9,557; interest, £3,716; income-tax, £2,420; and expenses of loans fund, £91; showing a surplus for the year of £3,514. The credit balance carried forward to next year is £1,853. The quantity of gas made during the year was 430 million cu.ft., an increase of 16,123,000 cu.ft., or 3·89%. The net income from residuals amounted to £17,135, equal to 14s. 5·5d. per ton of coal carbonized, or 73·89% of the cost, making the net cost of coal 5s. 1·3d. per ton.

Gas-fired Hot Water Apparatus for



Culinary Supply and
Dish Washing
in hotels and restaurants

Fully automatic
Clean
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Reliable

POTTERTONS' "EMPEROR"
Combination with dual-compartment cylinder delivering Hot Water for general requirements at about 140° F. and scalding water at 185° to 190° F. for Automatic Dish-Washer.

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Trade Notes

"Ideal" Central Heating.

The economies and advantages of a central heating installation is the subject of a recent folder published by Ideal Boilers and Radiators, Ltd., Ideal Works, Hull, in the form of a personal note addressed to the housewife. The folder gives several illustrated examples of houses with the cost of installing a central heating system. Its lay-out and colouring are both highly commendable.

"On Pleasure Bent."

Asbestos cement, in its many forms, plays a prominent part in the world of amusement. In fact, this versatile, reliable, and durable material has such a wide application that practically every building scheme to-day calls for its use in the form of roofing, flooring, partitioning, rain-water goods, and exterior and interior decoration. Many of these applications form the subject of a recently issued folder by Messrs. Turners Asbestos Cement Company, Asbestos House, Southwark Street, London, S.E. 1.

Visco "Savonius" Rotor Ventilator.

From the Visco Engineering Company, Ltd., Stafford Road, Croydon, we have received a folder dealing with the Company's rotor ventilators, which, it is claimed, will create a vacuum of 148·5% of the wind pressure. This, it is stated, is solely due to the unique principle upon which the ventilator is constructed. The "Savonius" rotor is direct coupled to a centrifugal fan of patented construction. The ratio between the dimensions of the rotor in proportion to those of the fan is scientifically designed to work at maximum speed consistent with the highest efficiency.

"Permac" Metal-to-Metal Jointing.

In a booklet issued by Messrs. Thomas & Bishop, Ltd., 37, Tabernacle Street, E.C. 2, examples from seven gas-works illustrate the use of "Permac" metal-to-metal jointing under the difficult conditions with which the Gas Engineer has daily to contend. "Permac" is claimed to be the original metal-to-metal jointing material, and the makers state that the number of examples given in the booklet might have embraced 700 gas-works, but conditions are similar and space is limited. "Permac" is equally suitable for any kind of joint—steam, water, gas, or oil with screw-pipe or flange joints—and it stands up to all temperatures and pressures.

Gas and Hygienic Food Products.

Rapid progress made by Fairmile Food Products, Ltd., Christchurch, Bournemouth, has necessitated the installation of new and better equipment for the manufacture of the firm's well-known pies, sausages, meat and game pastes, pastries, and many other high-grade foods. The Company have had installed a "Cox" super Heat-Trap gas-fired oven, which type of oven is made by Cox Ovenbuilders, Ltd., 91, King's Road, Tyseley, Birmingham, 11, and "Stott" gas-heated food cooking equipment, incorporating boiling pans, ham cooking plants, and steaming ovens. The "Stott" cooking equipment is, of course, made by Messrs. James Stott & Co. (Engineers), Ltd., Vernon Works, Oldham. The work of installation was carried out by the Bournemouth Gas and Water Company.

"Ermeto" Joints for Copper and Steel Tubes.

A booklet has been published by the British Ermeto Corporation, Ltd., 75, Victoria Street, S.W. 1, in which are given full details of the "Ermeto" joints for copper and steel tubing.

The "Ermeto" joint belongs to that group of pipe couplings usually known as "compression joints." Compression joints are designed primarily to avoid the use of screw thread on the pipe ends; screw threads necessitate additional wall thickness to accommodate the depth of thread, and thus elimination of screwing permits the use of much thinner, and, consequently, cheaper piping, without loss of strength or efficiency. The "Ermeto" principle, it is claimed, carries the design of the compression joint much nearer to perfection than any previous type while still retaining the essential advantages of the earlier types.

"Ermeto" joints are used for hydraulic pressures of over 7,000 lb. per sq.in., and for steam temperatures up to 780° F. Another advantage claimed for these joints is that they can be made and broken repeatedly without the necessity of fitting new rings. It is also stated that the joints are designed so as to permit an unobstructed flow and to be equally effective under either pressure or vacuum.

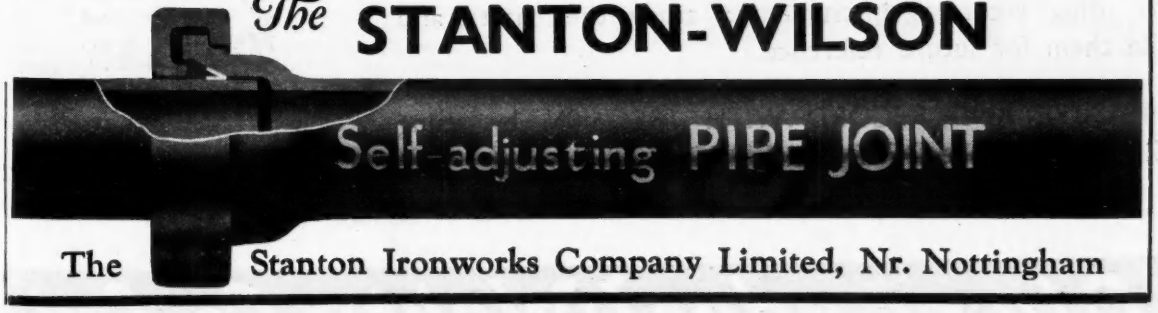
Traffic Vibration
Rigid or Self-adjusting Joints?

Not many of the problems brought into being by the remarkable growth of road transport during the last decade are capable of easy solution.

There is at least one exception, however. For instance, though much has been heard of the danger caused to historic buildings by traffic vibration, the harmful effects of such vibration on water and gas mains are not so apparent. To water and gas engineers responsible, however, for the maintenance of these essential public services, this was a very real problem until a few years ago, for rigidly-jointed mains could not be expected to withstand the severe vibration caused by modern conditions.

Some six years ago the Stanton Company introduced the Stanton-Wilson Self-adjusting pipe-joint to overcome this and similar difficulties. That it has successfully done so is proved by the fact that more than 1,500 miles of Stanton-Wilson mains have now been laid by over 750 public authorities.

The STANTON-WILSON



The Stanton Ironworks Company Limited, Nr. Nottingham

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PRECISION

use SIMMANCE PATENT

DEAD-BEAT *RECORDERS*

An indication is as fleeting as the spoken word, and useful and sufficient on occasions. Modern practice is based on records: the printed word, the photograph, the film. Failures and successes, all are recorded for future reference and study. Make a record of your operating conditions by using recording instruments; study the charts, and file them for future reference.

MEASURE AND RECORD WITH *PRECISION* by using Simmance Patent DEAD-BEAT RECORDERS.

Dead-Beat Recorders are supplied in ranges to meet customers' requirements within limits 0-1″ w.g. and 0-400 lbs. and any combinations of vacuum and pressure, e.g., ·4″-0-·2″, 2″-0-12″.

Alexander Wright & Co. Ltd.
WESTMINSTER · S · W · 1

Gas Markets and Manufactures

Stock Market Report

(For Stock and Share Lists, see later pages)

The three-week Account which closed last Friday was a notable exception to the usual tradition. Covering the August holiday, it is generally one of the quietest of the year, but despite this and the hot weather it has actually been the best for months past and some brokers already away have cut short their vacation to deal with the extra volume of business. During the past half-year the many adverse influences cropping up one after another have led to heavy liquidation and falls in prices, but the steadily increasing confidence during the past few weeks has brought about a refreshing increase in business and rise in values. The gilt-edged market has been particularly strong and closed higher again last week. Industrials were in good demand, iron, coal, and steel shares being good features, while the strength of metals gave a fillip to copper and tin shares. Gold shares, which felt the slump severely, recovered well though prices are still at attractive levels. Home rails with only a feeble support and foreign bonds were the only weak spots.

The big turnover in the more speculative groups left the Gas Market somewhat neglected and there was only a small volume of business recorded though quotations were well maintained. With one exception the few price changes in the Official List were on the up grade and included a gain of 2 points in Montevideo, an increase of 6d. in United Kingdom ordinary shares, and a rise of 1 point in Tottenham ordinary. It will be seen that the South Suburban new 3¾% redeemable preference stock, now officially quoted, has been included in the List at a price of 98-101. At the Provincial Exchanges the only alteration in the quotations was a rise of 1 point in Bristol ordinary to 116, while the nominal quotations in the Supplementary List again closed unchanged.

Interim dividends recently announced include the following: Watford 3½%, Woking "A" 5½%, and "B" £3 17s.%, all at the same rates as a year ago, and Derby 3% against 3½% for the corresponding period of 1936.

The Directors of the Sheppy Gas Company, which is controlled by the South-Eastern Gas Corporation, Ltd., are issuing for sale by tender such an amount of 4% perpetual preference stock as will realize a sum not exceeding £49,796 19s. 2d. at a minimum of £95%, at which price the yield is £4 4s. 2d.%. The Company's business has made rapid progress during the past few years and doubtless the proceeds of the issue are required to meet the extra distribution costs brought about by the increasing demand for gas. The last time for receipt of tenders is 12 noon on Aug. 23.

Current Sales of Gas Products

The London Market for Tar Products.

LONDON, *Aug.* 9.

There are no changes to report in the London Tar Products market, prices being as follows:

Pitch, 38s. per ton f.o.b.
Creosote, 6d. to 6¼d.
Refined tar, 3¾d.
Pure toluole, 2s. 6d.; pure benzole, 1s. 9d.; 95/160 solvent naphtha, about 1s. 8d.; and 90/160 pyridine, about 8s.; all per gallon naked at makers' works.

Tar Products in the Provinces.

Aug. 9.

The average prices of gas-works products during the week were: Gas-works tar, 23s. 6d. to 28s. 6d. Pitch—East Coast, 36s. to 37s. 6d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 36s. to 37s. 6d.* Toluole, naked, North, 2s. to 2s. 1d. Coal tar, crude naphtha, in bulk, North, 8½d. to 9d. Solvent naphtha, naked, North, 1s. 6¼d. to 1s. 6½d. Heavy naphtha, North, 1s. 8d. to 1s. 8½d. Creosote, *ex* works, in bulk, North, liquid and salty, 5d. to 5½d.; low gravity, 4⅝d. to 4½d. Heavy oils, in bulk, North, 5d. to 5½d. Carbolic acid 60's, 4s. 1½d. to 4s. 3d. Naphthalene, £18 to £20. Salts, 90s. to 95s., bags included. Anthracene "A" quality, 4½d. to 4⅝d. per minimum 40% purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Aug.* 7.

There is still a distinct scarcity of new business but, on the whole, prices are unaffected.

Crude gas-works tar.—The actual value is 37s. to 38s. per ton *ex* works in bulk.

Pitch continues dull with makers' quotations at about 30s. to 32s. 6d. per ton f.o.b. Glasgow for export, and 30s. per ton *ex* works in bulk for home trade.

Refined tar is in good demand at 3d. to 3¼d. per gallon free on rails for export, and 3½d. to 3¾d. per gallon *ex* works in buyers' packages for home trade.

Creosote oil.—Production is well looked after and values are not lower than the following: Specification oil, 5½d. to 5¾d. per gallon; low gravity, 6d. to 6¼d. per gallon; neutral oil, 5¼d. to 5½d. per gallon; all *ex* works in bulk.

Cresylic acid.—While new business is still quiet makers are very busy delivering against contracts previously arranged. To-day's values can be taken as under: Pale, 97/99%, 4s. 3d. to 4s. 5d. per gallon; dark, 97/99%, 4s. to 4s. 2d. per gallon; and pale, 99/100%, 4s. 8d. to 4s. 11d. per gallon; all *ex* works in buyers' packages.

Crude naphtha.—Only small quantities are available and are changing hands at round 6d. to 6¼d. per gallon *ex* works in bulk, according to quality and district.

Solvent naphtha.—90/160 grade is firmer at 1s. 5d. to 1s. 6d. per gallon, and 90/190 heavy naphtha is now valued at 1s. to 1s. 1d. per gallon.

Motor benzole is meantime still being quoted at round 1s. 4½d. to 1s. 5d. per gallon.

Pyridine.—Prices are nominal at 7s. to 8s. per gallon for 90/160 grade, and 8s. to 9s. per gallon for 90/140 grade.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole	0 9½	to	0 10	per gallon at works
Motor ,,	1 3	,,	1 3½	,, ,, ,,
90% ,,	1 4	,,	1 4½	,, ,, ,,
Pure ,,	1 8	,,	1 8½	,, ,, ,,

Contracts Advertised To-Day

Benzole Recovery Plant.
Clitheroe Gas Department. [p. 366.]

Carbonizing Plant.
Newcastle-under-Lyme Gas Department. [p. 366.]

Coal.
County Borough of Wallasey. [p. 366.]

Coal and Coke Handling Plant.
Newcastle-under-Lyme Gas Department. [p. 366.]

Retort House Building and Foundations.
Newcastle-under-Lyme Gas Department. [p. 366.]

Station Governors.
Newcastle-under-Lyme Gas Department. [p. 366.]

Waste Heat Boiler.
Brighouse Gas Department. [p. 366.]
Newcastle-under-Lyme Gas Department. [p. 366.]

Overseas Opportunities

Cast-Iron Pipes and Specials.

H.M. Trade Commissioner at Johannesburg reports that the Johannesburg Municipal Council is calling for tenders (Tender No. 572) for the supply and delivery of quantities of flanged cast-iron pipes of various lengths, short and medium bends, tees, crosses, bell-mouths, and blank flanges, &c.

Tenders, endorsed "Contract No. 572—Flanged cast-iron pipes and specials," should be addressed to the Town Clerk, Municipal Offices, Johannesburg, by whom they will be received up to noon on Aug. 18, 1937 (Ref. T. 25694/37).

Fertilizer Prices.

The following prices for sulphate of ammonia and "Nitro-Chalk" are announced by Imperial Chemical Industries, Ltd., for the 1937-38 season:

—	Per Ton. £ s. d.	For Delivery.
"Nitro-chalk"	7 10 6	Up to June 30, 1938
Sulphate of ammonia	7 3 6	August, 1937
,, ,,	7 5 0	September, 1937
,, ,,	7 6 6	October, ,,
,, ,,	7 8 0	November, ,,
,, ,,	7 9 6	December, ,,
,, ,,	7 11 0	January, 1938
,, ,,	7 12 6	February, ,,
,, ,,	7 14 0	March-June, 1938

All the above prices apply to minimum 6-ton lots delivered buyer's station; the usual extras to be charged for smaller quantities.

This installation, built for the Municipality of Svendborg, Denmark, is an interesting example of the modern Glover-West vertical retort plant designed for the smaller works. It is an eight-retort unit with fuel-gas producers equipped for breeze-burning, waste-heat recovery plant and electric lift. Coaling is by means of an automatic skip-hoist.

400 plants in 24 countries

WEST'S GAS IMPROVEMENT CO., LTD.

MANCHESTER: ALBION IRONWORKS, MILES PLATTING ■ **LONDON:** COLUMBIA HOUSE, ALDWYCH, W.C. 2

STOCK AND SHARE LIST

Official Quotations on the London Stock Exchange

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Aug. 6.	Rise or Fall on Week.	Transactions, Lowest and Highest Prices During the Week.
1,767,439	Stk.	Mar. 15	8	8	Alliance & Dublin Ord. ...	170—175	...	...
374,000	,,	June 21	4	4	Do. 4 p.c. Deb. ...	95—100	...	...
558,890	,,	Feb. 15	7	7	Barnet Ord. 7 p.c.	160—165	...	163
300,000	1	Apl. 5	1/4⅛	1/9⅜	Bombay, Ltd.	25/6—27/6	...	...
179,915	Stk.	Mar. 1	9⅜	9⅜	Bournemouth sliding scale ...	195—205	...	...
590,407	,,	,,	7	7	Do. 7 p.c. max. ...	161—166	...	...
493,960	,,	,,	6	6	Do. 6 p.c. Pref. ...	133—138	...	...
50,000	,,	June 21	3	3	Do. 3 p.c. Deb. ...	79—84	...	...
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	98—103	...	...
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	116—121	...	...
357,900	,,	Feb. 15	7½	7½	Brighton, &c., 6 p.c. Con. ...	155—160	...	...
649,955	,,	,,	6¾	6¾	Do. 5 p.c. Con. ...	138—143	...	142
205,500	,,	,,	6	6	Do. 6 p.c. 'B' Pref.	130—135	...	...
855,000	,,	Mar. 1	7	8	British Ord.	148—153	...	...
100,000	,,	June 21	7	7	Do. 7 p.c. Pref.	140—145	...	...
350,000	,,	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	108—113	...	...
120,000	,,	June	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	102—107	...	...
450,000	,,	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1⅛—2⅛	...	...
100,000	10	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1⅝—3⅛	...	...
150,000	Stk.	June 21	4½	4½	Do. 4½ p.c. Deb. ...	79—84	...	...
626,860	,,	July 19	6	6	Cardiff Con. Ord.	125—130*	...	...
237,860	,,	June 7	5	5	Do. 5 p.c. Red. Deb.	107—112	...	...
98,936	1	Apl. 5	2/-	2/-	Colombo Ord.	1⅜—1⅞	...	...
24,510	1	,,	1/4⅛	1/4⅛	Do. 7 p.c. Pref. ...	23/—25/-	...	...
739,453	1	Mar. 15	-/11·48	-/11·48	Colonial Gas Assn. Ltd. Ord.	18/—20/-	...	...
296,144	1	,,	1/3·30	1/3·30	Do. 8 p.c. Pref.	22/—24/-	...	...
1,775,005	Stk.	Feb. 1	5	5	Commercial Ord.	90—95	...	...
620,000	,,	June 7	3	3	Do. 3 p.c. Deb. ...	74—79	...	75½
286,344	,,	Feb. 15	5	5	Do. 5 p.c. Deb. ...	115—120	...	...
807,560	,,	Feb. 15	7	7	Croydon sliding scale ...	143—148	...	...
644,590	,,	,,	5	5	Do. max. div.	109—114	...	...
620,385	,,	June 21	5	5	Do. 5 p.c. Deb.... ...	113—118	...	116
239,000	,,	Feb. 1	5	5	East Hull Ord. 5 p.c.... ...	100—105	...	...
185,355	,,	Feb. 15	6	6	East Surrey Ord. 5 p.c. ...	122—127	...	125½
176,211	,,	June 7	5	5	Do. 5 p.c. Deb. ...	113—118	...	116
250,000	1	July 5	4	7	Gas Consolidation Ord. ...	20/—22/-	...	...
250,000	1	May 24	4	4	Do. 4 p.c. Red Cum. Pref.	19/—21/-	...	...
19,255,284	Stk.	Feb. 1	5⅔	5⅔	Gas Light & Coke 4 p.c. Ord.	24,9—25/9a	...	24/10½—25/3
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	83—86	...	83—84
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	100—103	...	101½—102½
2,993,000	,,	July 5	...	3⅔	Do 3⅔ p.c. Red. Pref.	100—103	...	102—102½
8,602,497	,,	May 24	3	3	Do. 3 p.c. Con. Deb. ...	79—82	−1	79½—80½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	111—114	...	...
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb....	110—113	...	111½—112†
700,000	,,	Mar. 1	25/58	3½	Do. 3½ p.c. Red. Deb....	96—101	...	...
270,466	,,	Feb. 15	6	6	Harrogate New Cons. ...	122—127	...	...
213,200	,,	Feb. 15	6	6	Hornsey Con. 3½ p.c. ...	120—125	...	...
5,600,000	,,	May 24	8	12	Imperial Continental Cap. ...	146—151	...	148—149½
223,130	,,	July 19	3½	3½	Do. 3½ p.c. Red. Deb. ...	89—94*	...	92½—93
285,242	,,	Mar. 1	8⅜	8⅜	Lea Bridge 5 p.c. Ord. ...	160—165	...	...
75,000	,,	May 24	†10	†10	Malta & Mediterranean ...	150—160	...	...
392,000	—	Apl. 1	5⅜	5⅜	Metropolitan (of Melbourne) 5⅜ p.c. Red. Deb.	98—103	...	...
231,978	Stk.	Feb. 15	5	5	M.S. Utility 'C' Cons. ...	102—107	...	...
968,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	95—100	...	...
360,075	,,	June 21	4	4	Do. 4 p.c. Deb. ...	97—102	...	...
148,955	,,	,,	5		Do. 5 p.c. Deb. ...	115—120	...	...
125,000	—	July 1	3⅜	3⅜	Do. 3⅜ p.c. Rd.Rg.Bds.	96—99	...	...
675,000	Stk.	May 3	†6	†9	Montevideo, Ltd.	89—94	+2	90½—91
250,000	,,	Feb. 15	7⅛	7⅛	North Middlesex 6 p.c. Con.	160—170	...	...
396,160	,,	Feb. 1	5	5	Northampton 5 p.c. max. ...	112—117	...	...
300,000	,,	Apl. 19	†9	†7	Oriental, Ltd....	162—167	...	...
468,537	,,	June 7	8	8	Plymouth & Stonehouse 5 p.c.	160—170	...	...
621,667	,,	Feb. 15	8¼	8¼	Portsmouth & Gosport Cons.	167—172	...	169½
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	105—110	...	...
73,350	,,	,,	...	5	Do. 5 p.c. Pref. ...	112—117	...	...
441,275	1	May 3	1/-	1/1⅛	Severn Val. Gas Cor. Ld. Ord.	21/—23/-	...	22/4½
460,810	1	Mar. 15	-/10½	-/10⅜	,, ,, 4½ p.c. Cum. Pref.	20/—22/-	...	...
133,201	Stk.	Feb. 15	5	8½	Shrewsbury 5 p.c. Ord. ...	140—145	...	...
1,371,752	1	May 3	1/2⅜	1/2⅜	South East'n Gas. Cn.Ld. Ord.	24-/—26/-	...	24 6—24/9
871,636	1	Mar. 1	-/10⅜	-/10½	Do. 4½ p.c. Red. Cum. Pref.	20/—22/-	...	20 6—21/6
498,818	1	,,	4	4	Do. 4 p.c. Cum. Pref. ...	18/6—20/6	...	20/-
450,000	Stk.	Feb. 15	4	4	Do. 4 p.c. Deb.	101—103	+1	...
150,000	,,	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	99—101	...	...
6,709,895	,,	Feb. 1	5	6	South Met. Ord.	107—110	...	108½—109½
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf. ...	132—137	...	133—134
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf. ...	98—101	...	...
1,895,445	,,	June 21	3	3	Do. 3 p.c. Deb. ...	75—80	...	77½—78
1,000,000	,,	July 5	5	5	Do. 5 p.c. Red. Deb....	106—111	..	110½
1,543,795	,,	Feb. 1	6	6	South Suburban Ord. 5 p.c....	122—127	...	...
512,825	,,	,,	5	5	Do. 5 p.c. Pref....	112—117	...	...
500,000	,,	,,	4	4	Do. 4 p.c. Pref....	95—100	...	...
250,000	,,	...	...	...	Do. 3⅜ p.c. Red. Pref.	98—101	...	...
888,587	,,	June 7	5	5	Do. 5 p.c. Deb....	115—120	...	...
250,000	,,	,,	4	4	Do. 4 p.c. Deb....	97—102	...	...
200,000	,,	...	...	...	Do. 3½ p.c. Red. Deb.	95—100	...	...
427,859	1	May 3	9⅜	1/2⅜	S. Western Gas & Water Ord.	19/—21/-	...	19/—20/-
160,523	1	Apl. 19	-/10⅜	-/10⅜	Do. 4½ p.c. Red. Cum. Pf.	20/—22/-	...	...
110,000	Stk.	June 21	4	4	Do. 4 p.c. Red. Deb. ...	97—102	...	...
750,541	,,	Feb. 1	5	5⅛	Southampton Ord. 5 p.c. ...	113—118	...	115—116½
148,836	,,	June 7	4	4	Do. 4 p.c. Deb.	97—102	...	96½—97
350,000	,,	Feb. 15	5⅛	5⅛	Swansea 5½ p.c. Red. Pref. ...	110—115	...	...
94,000	,,	June 7	3⅜	3⅜	Do. 3⅜ p.c. Red. Deb. ...	95—100	...	93—98
1,076,490	,,	Feb. 15	6¾	6¾	Tottenham and District Ord.	138—143	+1	...
409,835	,,	,,	5⅛	5⅛	Do. 5½ p.c. Pref....	123—128	...	...
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	110—115	...	112½—113½
371,850	,,	June 7	4	4	Do. 4 p.c. Deb. ...	97—102	...	...
750,000	1	Apl. 5	4	6	U. Kingdom Gas Cor. Ord.	20/—22/-	−/6	21/—21/3
936,338	1	May 3	4½	4½	Do. 4½ p.c. 1st Cum. Pref.	20/—22/-	...	20,9—21/1½
740,933	1	June 7	4½	4½	Do. 4½ p.c.2nd Non-Cum.Pf	17/—19/-	...	...
700,000	Stk.	Mar. 15	3⅜	3⅜	Do. 3⅜ p.c. Red. Deb. ...	96—99	...	97½—97⅝
373,939	,,	Feb. 15	7	7	Uxbridge, &c., 5 p.c. ...	150—155	...	...
133,010	,,	,,	5	5	Do. 5 p.c. Pref. ...	110—115	...	...
1,371,138	,,	Feb. 1	7	7	Wandsworth Consolidated ...	143—148	...	144—146
1,620,615	,,	,,	5	5	Do. 5 p.c. Pref ...	118—123	...	119
500,000	,,	,,	33/4	4	Do. 4 p.c. Pref. ...	97—100	...	...
1,343,964	,,	June 7	5	5	Do. 5 p.c. Deb. ...	115—120	...	119½
383,745	,,	,,	4	4	Do. 4 p.c. Deb. ...	97—102	...	...
558,342	,,	Feb. 1	7	7	Watford and St. Albans Ord.	142—147	...	...
200,000	,,	,,	5	5	Do. 5 p.c. Pref. ...	110—115	...	...
200,000	,,	,,	5⅛	5⅛	Do. 5⅛ p.c. Pref. ...	123—128	...	...
200,000	,,	June 7	4	4	Do. 4 p.c. Red. Deb.	97—102	...	...
100,000	,,	,,	3⅜	3⅜	Do. 3⅜ p.c. Red.Deb.	95—100	...	...

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BRISTOL EXCHANGE.								
347,756	Stk.	July 19	6	5	Bath Cons.	119—121*	...	...
1,667,250	,,	July 19	5	5	Bristol, 5 p.c. max.	115—117*	+1	...
120,420	,,	June 7	4	4	Do. 1st 4 p.c. Deb. ...	100½—102½	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	100½—102½	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	120—123	...	...
274,000	,,	July 19	5	5	Newport (Mon.) 5 p.c.max. ...	101—106*	...	...
13,200	12	Mar. 15	7	8	Pontyp'l Gas & W. 10 p.c. 'A'	13½—14½	...	...
13,600	10	,,	5	6	Do. 7 p.c. 'B'	12—12½	...	...
40,000	10	,,	5	6	Do. 7 p.c. 'C'	12—12½	...	...
140,778	Stk.	Feb. 1	5	5	Weston-super-Mare Cons. ...	112—113	...	...
64,338	,,	June 21	4	4	Do. 4 p.c. Deb.	96—98	...	...
33,340	,,	,,	7½	7½	Do. 7½ p.c. Deb.	157—160	...	...
LIVERPOOL EXCHANGE.								
157,150	Stk.	Feb. 1	5	6½	Chester 5 p.c. Ord.	106—111	...	...
92,500	,,	June 21	4	4	Do. 4 p.c. Pref.	97—101	...	...
36,430	,,	,,	3	3½	Do. 3½ p.c. Deb.... ...	89—92	...	...
41,890	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	98—102	...	...
2,167,410	,,	Feb. 15	6	6	Liverpool 5 p.c. Ord. ...	126—128	...	...
245,500	,,	June 21	5	5	Do. 5 p.c. Red. Pref. ...	99—104	...	...
306,083	,,	July 1	4	4	Do. 4 p.c. Deb. ...	102—104	...	...
106,280	,,	Feb. 1	10	10	Preston 'A' 10 p.c.	210—220	...	...
188,219	,,	,,	7	7	Do. 'B' 7 p.c.	150—160	...	...
NEWCASTLE EXCHANGE.								
122,577	Stk.	Feb. 1	8	8	Blyth 5 p.c. Ord.	166—168	...	...
732,000	,,	Feb. 15	5	5	Hartlepool G. & W. Cn. & New	122—123	...	...
2,061,315	,,	Feb. 1	5	5½	Newcastle & Gateshead Con.	24.9—25/3a	...	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	100—101	...	...
776,706	,,	June 21	3½	3½	Do. 3½ p.c. Deb. ...	91—92	...	...
277,285	,	Nov. 2	5	5	Do. 5 p.c. Deb. '43...	108—109	...	...
332,351	,	Feb. 1	6	6	Sunderland 6 p.c. max. ...	139—141	...	...
NOTTINGHAM EXCHANGE.								
542,270	Stk.	Mar. 1	7	9	Derby Con.	155—165	...	...
55,000	,,	June 7	4	4	Do. 4 p.c. Deb.	100—105	...	...
84,750	,,	Feb. 17	5	12	Long Eaton 'A' Ord. ...	...	...	...
50,000	,,	,,	4	10	Do. 'B' Ord. ...	...	...	...
20,000	10	June 21	5	5	Do. 5 p.c. Pref. ...	10—12	...	...
80,000	Stk.	,,	5	5	Do. 5 p.c. Deb. ...	105—110	...	...
SHEFFIELD EXCHANGE.								
10,000	Stk.	Feb. 15	10	10	Great Grimsby 'A' Ord. ...	210—220	...	...
6,500	,,	,,	10	10	Do. 'B' Ord. ...	210—220	...	...
79,000	,,	,,	10	10	Do. 'C' Ord. ...	205—210	...	...
1,806,339	,,	Feb. 15	6	6½	Sheffield Cons.	144—146	...	...
95,000	,,	July 5	4	4	Do. 4 p.c. Deb.	100—103	...	...

Supplementary List of Stocks and Shares not Officially Quoted

202,152	Stk.	Mar. 15	25/-b	25/-b	Ascot Ord.	102—107	...	...
128,182	,,	July 5	5	5	Do. 5 p.c. Pref.	108—113	...	...
474,410	1	May 24	5	5	Assd. Gas and Water Ord. ...	19/6—21/6	...	20/6
500,000	1	,,	4½	4½	Do. 4½ p.c. Cum. Pref. ...	19/6—21/6	...	...
500,000	Stk.	Mar. 15	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...	97¾
31,035	1	...	...	...	Associated Utilities 4 p.c. Pref.	17/—19/-	...	...
100,000	Stk.	...	...	...	Do. 3½ p.c. Red. Deb.	95—100	...	...
17,000	,,	Feb. 15	8	8	Bognor Orig. Ord. 'A' ...	160—170	...	...
62,210	,,	,,	8	8	Do. New Addl. 'A' ...	160—170	...	...
87,160	,,	,,	7	7	Do. New 7 p.c. max. ...	141—146	...	...
37,440	,,	Feb.	10	10	Cam. Univ. & Town 10 p.c.max.	195—205	...	...
125,970	,,	,,	7	7	Do. 7 p.c. max.	137—142	...	...
39,025	,,	,,	5	5	Do. 5 p.c. max.	98—103	...	...
65,000	,,	Mar. 1	7½	8½	Eastbourne 'A' 5 p.c. ...	160—165	...	...
198,000	,,	,,	6	7	Do. 'B' 3½ p.c.	130—135	...	...
112,312	,,	,,	5	5	Do. 5 p.c. Pref.	110—115	...	...
130,000	,,	June 21	5	5	Do. 5 p.c. Deb.	115—120	...	...
24,000	30	Feb. 1	8½	8½	Great Yarmouth 8½ p.c. max.	45—50	...	...
59,400	30	,,	7½	7½	Do. 7½ p.c. max.	40—45	...	...
51,160	Stk.	June 7	5½	5½	Do. 5½ p.c. Deb.... ...	120—125	...	...
152,600	,,	Feb. 15	8	9	Guildford Cons.	172—177	...	...
54,055	,,	,,	5	5	Do. 5 p.c. Pref.	112—117	...	...
68,250	,,	June 7	5	5	Do. 5 p.c. Deb.	113—118	...	...
156,600	,,	Feb. 15	7½	7½	Hampton Court Cons. ...	160—165	...	...
73,620	,,	Mar. 15	8½	8½	Luton Cons. 'A'	166—171	...	...
107,960	10	Mar. 15	4	5½	Mid Kent Ord.	9—10	...	...
230,940	Stk.	Feb. 15	10	10	Oxford & District Ord. ...	207—212	...	...
47,112	,,	,,	5	5	Do. 5 p.c. Pref.	110—115	...	...
50,000	,,	,,	6	6	Do. 6 p.c. Red. Pref. ...	112—117	...	...
126,193	,,	May 3	7½	7½	Peterborough Ord.	159—169	...	...
64,990	,,	Mar. 15	6½	7½	Redditch Ord.	127—137	...	...
166,850	,,	Feb. 15	8	8	Romford Ord.	157—167	...	...
60,000	,,	,,	4	4	Do. 4 p.c. Pref.	97—100	...	...
44,000	,,	Mar. 15	5	5	Do. 5 p.c. Deb.	115—120	...	...
25,570	,,	Feb. 15	5½	5½	Rugby 5½ p.c. Pref.	125—130	...	...
25,000	,,	,,	6	6	Do. 6 p.c. Red. Pref. ...	106—111	...	...
42,750	,,	June 7	5½	5½	Do. 5½ p.c. Deb.	122—127	...	...
10,950	,,	Mar. 1	8	8	Ryde Ord.	160—165	...	...
136,191	,,	Feb. 15	5	7	Scarborough Ord.	123—133	...	...
27,825	,,	Feb. 1	8	8	Shanklin & Ventnor Cons. ...	158—168	...	...
270,086	,,	Mar. 15	7	7	Slough Ord.	137—142	...	...
21,000	,,	June 21	5	5	Do. 5 p.c. Deb.... ...	112—117	...	...
28,872	1	May 24	5½	5½	S. Midland Gas Cpn. Ltd. Ord.	19/—21/-	...	...
28,866	1	Mar. 15	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	18/6—20/6	...	...
137,730	Stk.	Feb. 15	7	7	Southgate & Dist. 7 p.c. max.	140—145	...	...
62,500	,,	,,	5	5	Do. 5 p.c. Pref.	110—115	...	...
117,228	,,	Feb. 15	6	5	Swindon Cons.	108—113	...	...
60,425	,,	June 7	5	5	Do. 5 p.c. Deb.	110—115	...	...
64,380	,,	June 7	5	5	Torquay and Paignton 5 p.c. Pf	110—115	...	...
130,000	,,	Feb. 15	5	8	Wakefield Ord.	126—131	...	...
81,650	,,	,,	5	5	Do. 5 p.c. max.	103—108	...	...
82,000	,,	Feb. 1	6	6	Weymouth Ord.	103—108	...	...
98,384	,,	Feb. 1	6	6	Wolverhampton 6 p.c. Pref....	125—130	...	...
160,000	,,	June 21	5½	5½	Do. 5½ p.c. Rd. Db	108—113	...	...
370,000	,,	Feb. 15	4½	6	York Cons.	105—110	...	...
90,000	,,	June 21	5	5 1	Do. 5 p.c. Red. Deb. ...	105—110	...	...
133,640	,,	July 19	6½	6½	Yorktown (Cam.) 5 p.c Cons.	128—133*	...	...
120,000	,,	,,	5	5½	Do. 5 p.c. Pref.	108—113*	...	...
35,000	,,	June 7	5½	5½	Do. 5½ p.c. Deb.... ...	123—128	...	...

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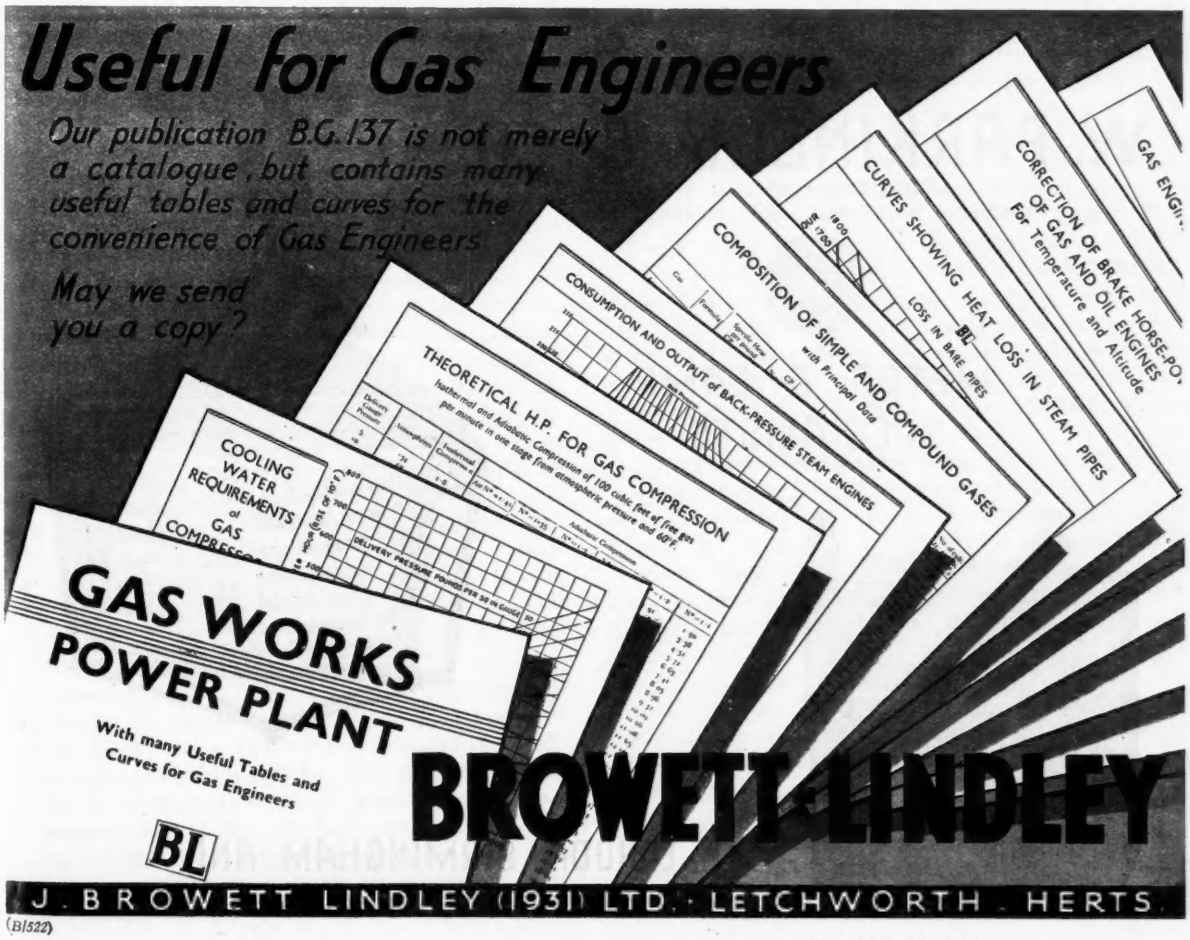
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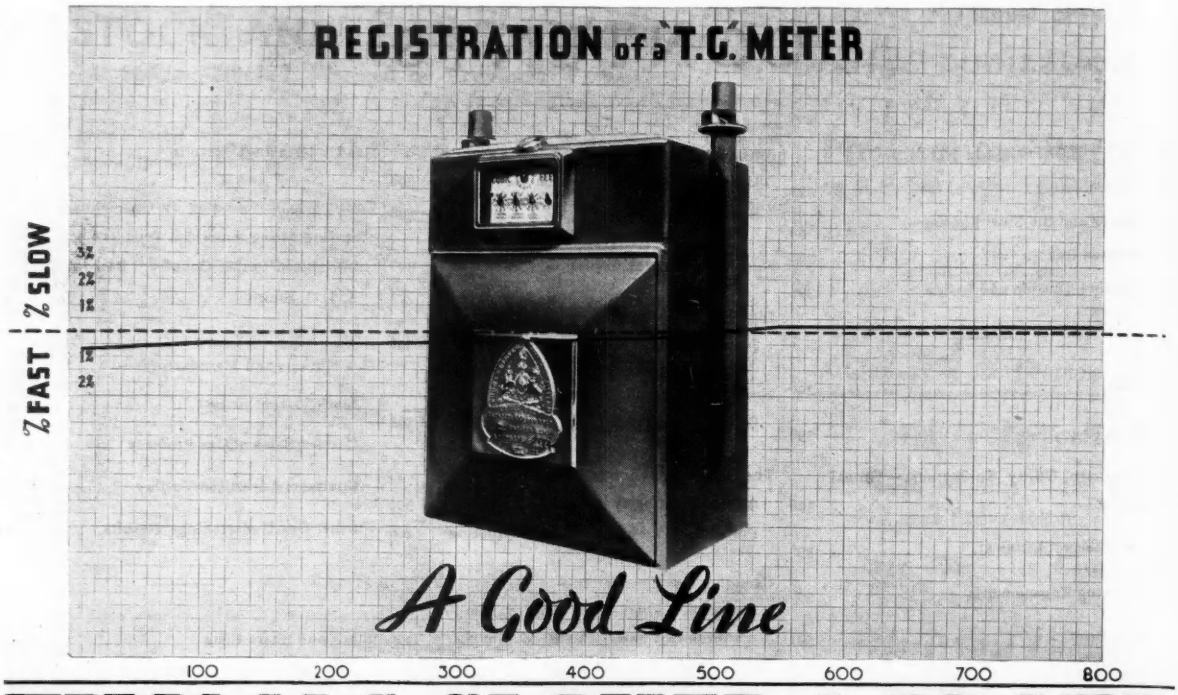

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